



ecowarm®
RADIANTBOARD™

APPLICATION AND INSTALLATION MANUAL

**FEATURING NEW ECOWARM
RADIANTBOARD EPS™ PANEL**



ecowarmradiantheat.com

WBI

THE RADIANT PANEL COMPANY

2024 EDITION — VERSION 24.2

NOTES:

[illegible]

NEW IN THIS EDITION: ECOWARM® RADIANTBOARD™ AND ECOWARM® RADIANTBOARD EPS™

ECOWARM® RADIANTBOARD™ APPLICATION & INSTALLATION MANUAL © AUGUST 2024 VERSION 24V2

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U.S. PATENT #6,533,185 AND OTHER PATENTS PENDING

APPLICATION AND INSTALLATION MANUAL —

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INSTALLER CAUTION

This manual is deemed to be current at the time of publication. It is the installer's responsibility to install according to the most current *Application and Installation Manual*. This guide does not purport to address all relevant issues; it assumes a knowledge of good practices in both hydronics and construction methods. Installers should always consult all relevant local, regional and national codes, and adhere to good construction practice. Ecowarm should only be installed by knowledgeable, qualified installers. Ecowarm installations frequently require the coordination of trades, typically mechanical and flooring.

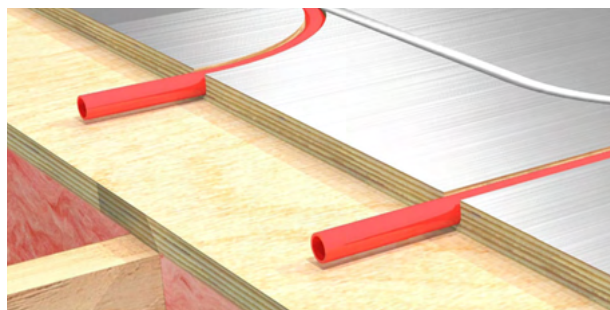
Any issues regarding this coordination should be worked out in advance. Failure to follow the instructions of this guide, failure to adhere to relevant local, regional and national codes, failure to coordinate trades, and failure to follow good construction practice may cause an unsatisfactory result. See also *limitations of use* elsewhere in this publication. The limitations and instructions of use for PEX pipe and other hydronic components, as provided by their respective manufacturers, shall also be referenced and adhered to during installation; this manual does not address many aspects of a hydronic installation.

WE NOW HAVE TWO ECOWARM® PRODUCTS



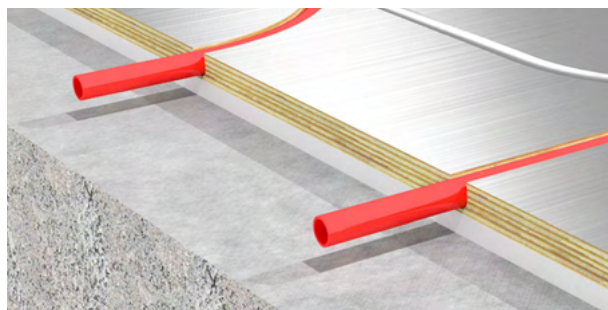
ECOWARM® RADIANTBOARD™

The Ecowarm® panel is higher performing and more sustainable with no added formaldehyde, new moisture resistance levels, and high recycled content certifications. Panels are installed by gluing and screwing or cross stapling to a subfloor.



ECOWARM™ RADIANTBOARD EPS™

Our new Ecowarm EPS™ panel is the same high quality board but available with many thicknesses of durable, high quality EPS foam. The panels are normally attached to the subfloor with adhesive and in some cases additionally anchored to the concrete.



WHY IT WORKS SO WELL



Everyone loves the hydronic radiant heating Ecowarm® RadiantBoard – and now more efficient, more responsive, more environmentally responsible and compatible with standard construction practices. Ideal for new construction and remodeling alike: low profile, lightweight, and with a rapid response performance. Ecowarm® RadiantBoard™ offers consumers genuine advances in the best heating system you can buy. . . hydronic radiant heat.

Non-structural Ecowarm® RadiantBoard™ is designed specifically for subfloor applications. Ecowarm® RadiantBoard™ is constructed from 6-7 layer plywood covered with aluminum that spreads heat evenly and quickly from warm water circulating through hydronic tubing. Ecowarm® RadiantBoard™ heats rapidly and is easy to control using setback thermostats for maximum energy efficiency. It contains just enough thermal mass to be effective and to allow for easy temperature control.

No other product offers our unique combination of performance, cost-effectiveness, ease of installation, and environmental prudence. Ecowarm® RadiantBoard™ is typically glued and screwed, or glued and stapled to a wood subfloor. Then 1/2" PEX tubing, which will carry warm water, is walked into the groove. Heat is transferred from the tubing to the conductive aluminum layer and the board.

QUICK RESPONSE

- *Low profile light weight for easy installation*
- *Avoid the moisture, mess, and weight of gypsum, cement, or concrete*
- *Radiant installations are easy to schedule with no lost time waiting for concrete to cure*

BOARD CONSTRUCTION

Ecowarm® RadiantBoard™ is manufactured from 6 to 7-ply plywood, cut to a versatile size, grooved with one of two patterns – Straight or Combo – then laminated with a substantial top layer of highly conductive aluminum (with recycled content, adhered with a water-based glue (no-VOC when dried) to efficiently disperse and transfer heat away from the groove to the entire surface area of the board.



ACCELERATION

Acceleration is the measure of how quickly a radiant heating system responds. Aluminum is approximately 1000 times more conductive than wood. Thus the layer of aluminum on Ecowarm® RadiantBoard™, which extends down into the groove, significantly enhances both the transfer of heat and the evenness of the panel heat distribution.

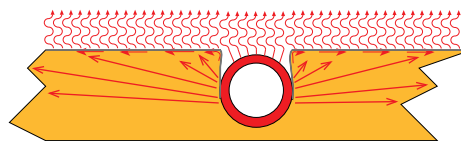
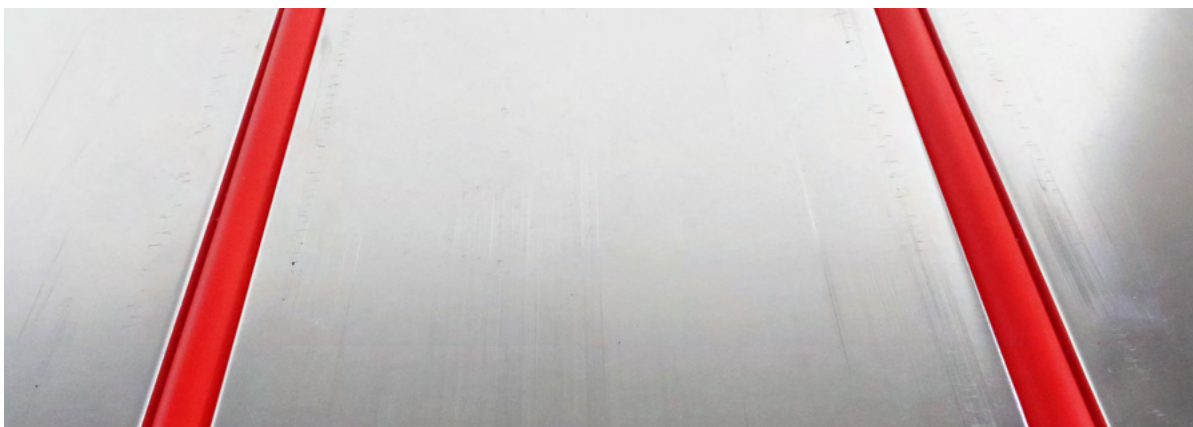


Illustration A-1: Board cross-section, radiant heat disbursed

Illustration A-1 shows how heat transfers through Ecowarm® RadiantBoard™. The thin profile and metal layer contribute to the superior acceleration and deceleration. Traditional radiant heating systems in concrete work well, but they must first charge (heat) a large thermal mass before heat will begin to radiate from the panel. They also accelerate and decelerate very slowly due to the large thermal mass, which can make these systems hard to control. In contrast, Ecowarm® RadiantBoard™ panels are thin and dense. The highly conductive aluminum layer produces a greatly improved response time with almost no overheating since there is little “thermal lag” to overcome. The heating performance can be controlled with standard set-back thermostats.

ECOWARM® RADIANTBOARD™

The Ecowarm® RadiantBoard™ aluminum top layer provides multiple benefits. It is highly conductive and moisture resistant. Sealing the edges and grooves with silicone caulking provides significant moisture protection. Sealing also provides a barrier to the transmission of any out-gassing from the board. Ecowarm® RadiantBoard™ is manufactured to meet the Federal Housing Authority (FHA) and California Air Resources Board (CARB) formaldehyde out-gassing standards. Ecowarm® RadiantBoard™ has virtually no detectable levels of formaldehyde out-gassing because we use a benign, water-based glue that has no-VOC when dried.



ADVANTAGES OF ECOWARM® RADIANTBOARD™



Hydronic radiant heating is the most comfortable and efficient way to heat your home or building, with many construction benefits and unsurpassed flexibility in zoning. For many years, typical radiant systems involved embedding tubing in concrete slabs or pouring “light-weight concrete” over tubing stapled to sub-floors. Designers overlooked the limitations and disadvantages of concrete systems due to a lack of good alternatives. **Now Ecowarm® RadiantBoard™ provides that alternative.** It is designed for the application of hydronic radiant tubing over a variety of construction types. It may be used in new construction and also the growing retrofit market. Ecowarm® RadiantBoard™ provides a superior performing radiant heating system while only adding 3/4” to the existing floor height. Application of the system is easy: only two board designs are required for installation.

CONSTRUCTION FRIENDLY Ecowarm® RadiantBoard™ eliminates the need for joist up-sizing, double plating, and hardwood nailing strips associated with gypsum-based concrete radiant heating systems. Ecowarm® RadiantBoard™ eliminates substantial drying costs required by moisture-laden concrete and gypsum-based cement and eliminates scheduling and curing delays, saving time and money on installation costs.

COST FRIENDLY Ecowarm® RadiantBoard™ is installed using conventional construction practices and commonly used tools. With a layout plan, the two board panel patterns can be systematically arranged on the subfloor. Not only are the boards lightweight, they are also easy to handle, cut and attach.

FLOORING FRIENDLY Ecowarm® RadiantBoard™ provides a quality flat surface for floor covering assemblies. Each of these flooring assemblies is supported by detailed drawings and instructions illustrated in this Installation Manual.

HARDWOOD	ENGINEERED WOOD	TILE / STONE
CARPET	VINYL / RESILIENT FLOORING	LAMINATE

PLANET FRIENDLY – UNIQUELY GREEN Ecowarm® RadiantBoard™ is made from 6 or 7-ply USA plywood. The aluminum layer contains recycled content and is adhered with a water based adhesive that has no-VOC on drying.



TYPICAL R-VALUES OF FLOOR COVERINGS

Material	Typical R-Value	R-Value Per Inch	Typical Thickness
Plywood	0.825	1.10	0.750
Plywood Underlayment (1/4)	0.275	1.10	0.250
Softwood	0.825	1.10	0.750
Sheet Vinyl	0.200	1.60	0.125
Vinyl Composition Tile (VCT)	0.200	1.60	0.125
Linoleum	0.400	1.60	0.250
Linoleum	0.200	1.60	0.125
Dense Rubber Flooring	0.250	1.30	0.325
Recycled Rubber Flooring	1.100	2.20	0.500
Cork	1.125	3.00	0.375
Cork/MDF/Laminate	1.175	2.35	0.500
Brick	3.375	2.25	1.500
Marble	0.400	0.80	0.500
Ceramic Tile	0.250	1.00	0.250
Thinset Mortar	0.050	0.40	0.125
MDF/Plastic Laminate	0.500	1.00	0.500
Laminate Floor Pad	0.300	1.92	0.160
Engineered Wood	0.250	1.00	0.250
Engineered Wood	0.375	1.00	0.375
Engineered Wood	0.625	1.00	0.625
Engineered Wood	0.750	1.00	0.750
Engineered Wood Flooring Pad	0.200	1.60	0.125
Engineered Bamboo	0.720	0.96	0.750
Oak	0.638	0.85	0.750
Ash	0.750	1.00	0.750
Maple	0.750	1.00	0.750
Pine	0.975	1.30	0.750
Fir	0.900	1.20	0.750
Carpet Pad/Slab Rubber 33lb	0.320	1.28	0.250
Carpet Pad/Slab Rubber 33lb	0.480	1.28	0.375
Carpet Pad/Slab Rubber 33lb	0.640	1.28	0.500
Carpet Pad/ Waffle Rubber 25 lb	0.620	2.48	0.250
Carpet Pad/Waffle Rubber 25 lb	1.240	2.48	0.500
Hair Jute	1.940	3.88	0.500
Hair Jute	1.250	3.88	0.325
Prime Urethane	1.400	4.30	0.325
Prime Urethane	2.150	4.30	0.500
Bonded Urethane	1.350	4.20	0.325
Bonded Urethane	2.100	4.20	0.500
Carpet	0.700	2.80	0.250
Carpet	1.050	2.80	0.375
Carpet	1.400	2.80	0.500
Carpet	1.750	2.80	0.625
Carpet	2.100	2.80	0.750
Wool Carpet	1.575	4.20	0.375
Wool Carpet	2.100	4.20	0.500



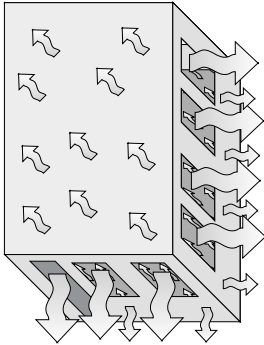


Illustration A-2
Account for all heat losses of the building

HEAT LOSS ANALYSIS AND SYSTEM DESIGN

Systematic heat loss and design for the structure to be heated should be done prior to any Ecowarm® RadiantBoard™ installation. As with all floor heating jobs, a detailed and accurate heat loss must be calculated in order to determine proper design conditions. This may be provided by a design service (see Design Services). Refer to RPA (Radiant Professionals Alliance) Guidelines for the Installation of Radiant Panel Systems for standards on insulation and heat loss.

DESIGNER'S NOTE

Perform the heat loss analysis of your structure at the design stage. This way, the selection of floor coverings can be made with system requirements in mind. If the heat loss is too high add insulation or auxiliary heat. In a very high heat loss room, Ecowarm® RadiantBoard™ can be added to the walls or ceilings for extra heat.

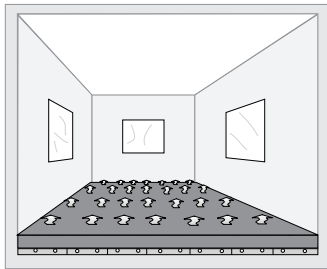


Illustration A-3
Always account for the resistance of floor coverings

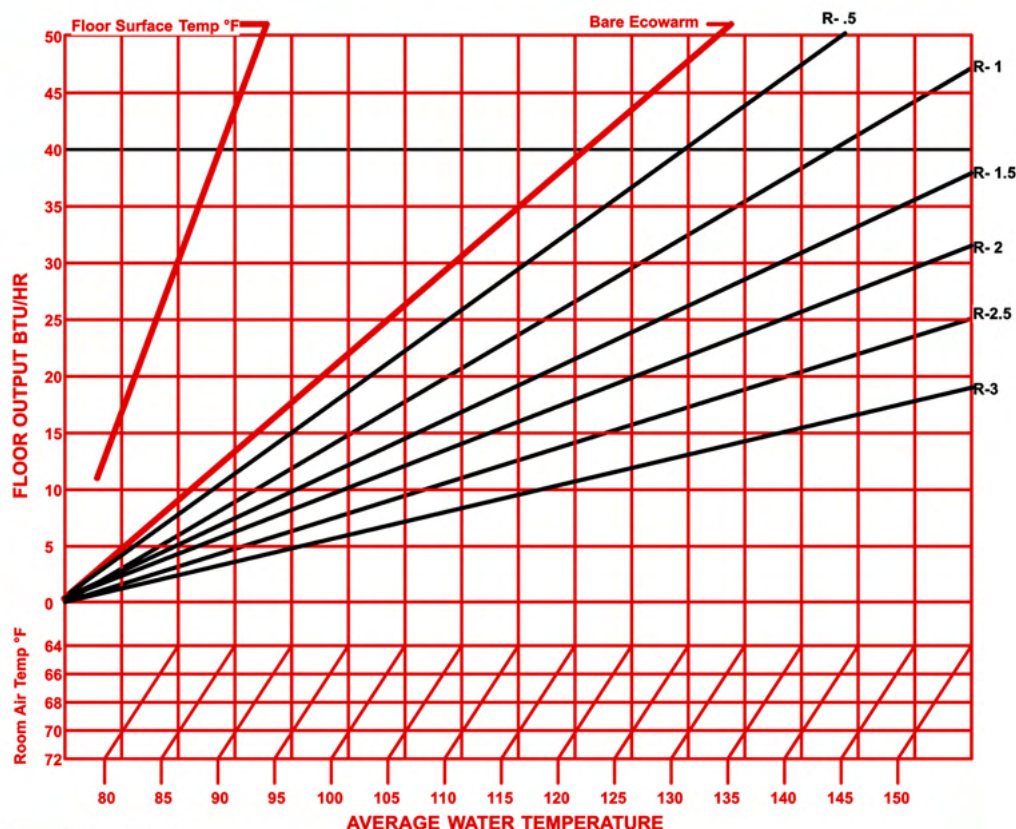
R-VALUE OF FLOOR ASSEMBLIES

Ecowarm® RadiantBoard™ is compatible with a wide variety of floor coverings. However, it is important to realize that all floor coverings offer a resistance to heat transfer, typically measured by their R-Value. The higher the R-Value of a floor covering, the higher the average water temperature required to overcome this resistance and generate the desired amount of heat. As with any radiant heating system, if the R-value of floor coverings above Ecowarm® RadiantBoard™ is excessive, performance will be compromised due to lack of heat transfer, or would require exceeding the 150* maximum recommended supply water temperature for Ecowarm® RadiantBoard™.

DESIGNER'S NOTE

Average water temperature means the average of the supply and return water temperatures flowing to and from the loop. Ecowarm® RadiantBoard™ is designed with a 20°F temperature drop. This means the supply water temperature would typically be 10°F higher than the average water temperature.



**SYSTEM OUTPUT CHART C-1**

HOW TO USE THIS CHART: Calculate the heating output required in BTU/hr/sq.ft. Proceed horizontally right until you intersect the R-Value line of your floor covering(s), then drop straight down vertically to the horizontal line of desired room temperature, then angle down to the left to read the average required water temperature. For example, if you need 15 BTU/hr/SF with an R-.5 floor covering and a 70°F room temperature, you'll need 93°F average water temperature.

DESIGNER'S NOTE

Learn about the resistance of intended floor coverings at the design stage and make sure it is within the requirements of the system. Your calculation should include the resistance of the whole flooring assembly above the Ecowarm® Radiant Board. If you are unfamiliar with hydronic design, good practices and the physics of hydronic heat transfer, you should not design a Ecowarm® RadiantBoard™ system.

CAD LAYOUT & DESIGN SERVICES

Third party services can provide complete system design and CAD layouts for the installation of Ecowarm® RadiantBoard™. Contact your sales person for details. All systems should be installed by qualified installers.



Custom CAD layouts are particularly useful for first time installers.



LOOP LENGTH AND TEMPERATURE CHART C-2

ECOWARM™ RadiantBoard™ 350' LOOPS 20°F TEMPERATURE DROP

LENGTH (L)	FLOW (GPM)	PIPE ID	FT OF HD (HF)	VELOCITY FT/SEC	BTU/SQ.FT.
350	0.1	0.475	0.24	0.18	2.86
350	0.25	0.475	1.29	0.45	7.14
350	0.5	0.475	4.66	0.91	14.29
350	0.75	0.475	9.86	1.36	21.43
350	1	0.475	16.79	1.81	28.57
350	1.25	0.475	25.37	2.26	35.71
350	1.47	0.475	34.24	2.66	42.00

Shaded Rows Have High Head Loss

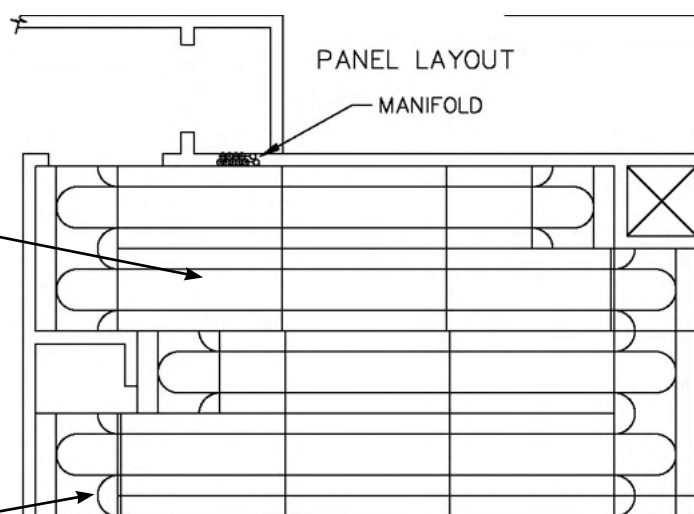
ECOWARM™ RADIANTBOARD™ 250' LOOPS 20°F TEMPERATURE DROP

250	0.1	0.475	0.17	0.18	4
250	0.25	0.475	0.92	0.45	10
250	0.5	0.475	3.33	0.91	20
250	0.75	0.475	7.04	1.36	30
250	1	0.475	11.99	1.81	40
250	1.05	0.475	13.12	1.90	42

STRAIGHT



COMBO



DESIGNER'S NOTE

Remember, average water temperature means the average of the supply and return water temperatures flowing to and from the loop. Most typically, Ecowarm® RadiantBoard™ is designed with a 20°F temperature drop. This means that the supply water temperature would typically be 10°F higher than the average water temperature.

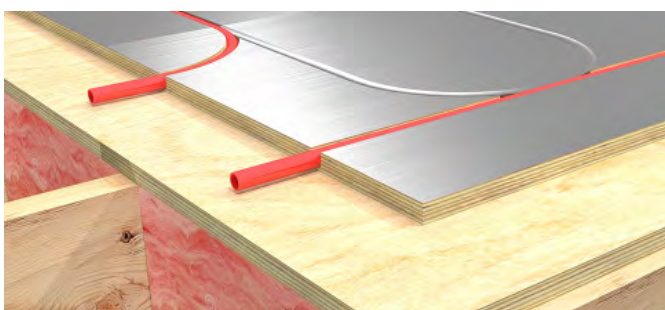


ECOWARM PRODUCTS



ECOWARM® RADIANTBOARD™

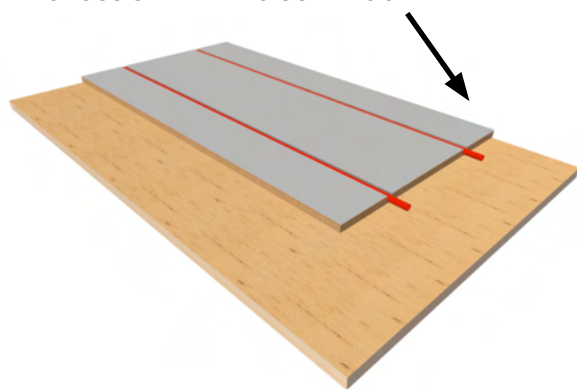
Premium radiant panel with excellent performance. Constructed with 6 or 7 layer plywood with a highly-conductive aluminum layer bonded on top. It is either glued and screwed or cross stapled to a sub-floor.



Ecowarm® RadiantBoard™ is constructed from 6-7 ply plywood and a conductive aluminum laminate. The radiant system is designed for both new construction and remodeling over a subfloor or cement.

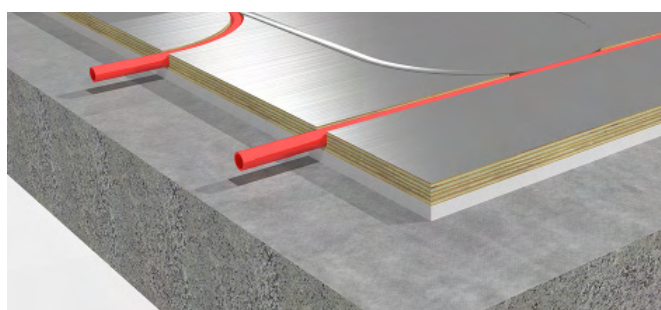
The system includes Straight and End Combo panels laid out and installed in a pattern. The pattern creates the pathway into which 1/2" PEX tubing is placed that meet standards specified in this manual.

MOST FREQUENTLY GLUED AND SCREWED OR GLUED AND CROSS STAPLED TO SUB-FLOOR



ECOWARM® RADIANTBOARD EPS™

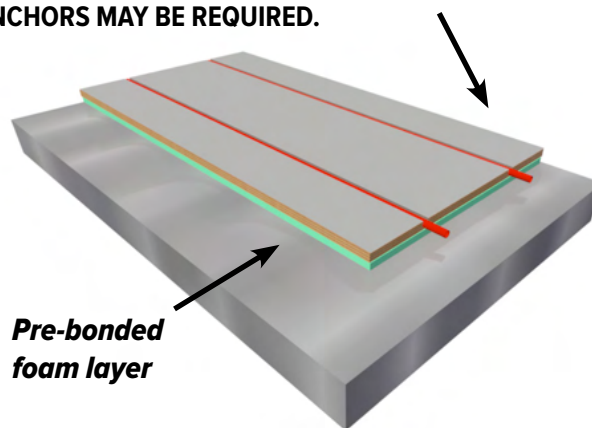
The same high quality radiant panel but with EPS foam pre-bonded to the bottom of the board. It is normally adhered to a concrete subfloor and where necessary with additional anchors into the concrete.



Heat up, not down. Ecowarm® RadiantBoard EPS™ combines our traditional Ecowarm® panels with an underlayment of EPS insulation. This unique combination directs heat where you want it most.

- Insulating and Sound Dampening.
- High Compression. High Impact Assembly.
- Flooring Goods Friendly.
- Water/ Mold Resistant EPS Foam.

ATTACHED WITH ADHESIVE TO CONCRETE. EXTRA ANCHORS MAY BE REQUIRED.



PART NUMBERS AND RELATED INFORMATION



Ecowarm® RadiantBoard™ Part Information

PART NUMBER	DESCRIPTION	DIMENSION	WEIGHT	LBS PER SQ.FT	R VALUE	NO / PALLET
ECO-EWP-S2	STRAIGHT	23.5" X 47" X 0.75	15.9	2.07	0.9	74
ECO-EWP-C2	COMBO	23.5" X 47" X 0.75	15.9	2.07	0.9	74

Ecowarm® RadiantBoard™ is widely used in new and retrofit construction over wood subfloors. It is a premium, high output product designed to offer an optimal blend of cost, performance, environmental sustainability and experienced product support.

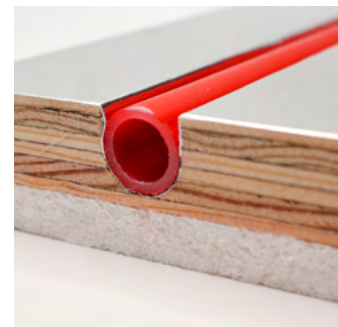


Ecowarm® RadiantBoard™ EPS Part Information

PART NUMBER	DESCRIPTION	DIMENSION	WEIGHT	LBS PER SQ.FT	R VALUE	NO / PALLET
ECO-EPS0375-S2	STRAIGHT .375" Foam	23.5" X 47" X 1.125"	16.4	2.1	2.7	72
ECO-EPS05-S2	STRAIGHT .05" Foam	23.5" X 47" X 1.25"	16.6	2.2	3.3	66
ECO-EPS075-S2	STRAIGHT .75" Foam	23.5" X 47" X 1.5"	16.9	2.2	4.4	56
ECO-EPS10-S2	STRAIGHT 1" Foam	23.5" X 47" X 1.75"	17.2	2.2	5.6	48
ECO-EPS20-S2	STRAIGHT 2" Foam	23.5" X 47" X 2.75"	18.6	2.4	10.3	30
ECO-EPS375-C2	COMBO .375" Foam	23.5" X 47" X 1.125"	16.4	2.1	2.7	72
ECO-EPS05-C2	COMBO .5" Foam	23.5" X 47" X 1.25"	16.6	2.2	3.3	66
ECO-EPS075-C2	COMBO .75" Foam	23.5" X 47" X 1.5"	16.9	2.2	4.4	56
ECO-EPS10-C2	COMBO 1" Foam	23.5" X 47" X 1.75"	17.2	2.2	5.6	48

Ecowarm® RadiantBoard EPS™ Radiant Floor Panel Heating System

Perfect for modern homes and very suitable for retro-fitting old basements with uninsulated slabs. Can also be easily used on radiant walls and ceilings as well as upgrading insulation over a crawl space. Alternate thicknesses of foam may be special ordered. The 3/8" and 1" are standard foam thickness.



Faster response and higher efficiency over concrete, as opposed to the older method of putting the hydronic tubing in the slab. Use quality 1/2" PEX pipe as specified in *Associated Products Appendix* of this manual. These pipes measure on the outer diameter .625" +/- .004" and must meet the standards specified. **SEE ALSO:** Unfoiled special order blank filler boards may be available in some markets on Page 63 in Appendix 1. Call your sales person for more information.



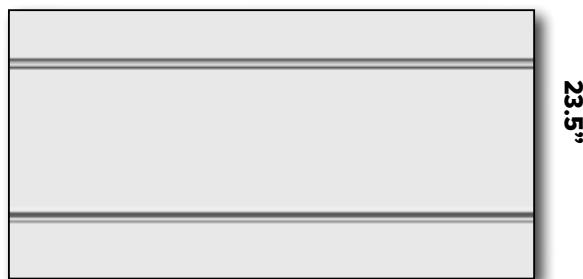
SYSTEM **INSTALLATION**

INSTALLATION: UNDERSTAND THE PRODUCT

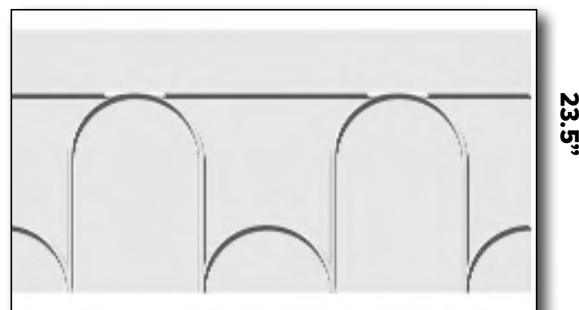
COMPONENTS

Ecowarm® RadiantBoard™ and Ecowarm® RadiantBoard EPS™ contain two different board configurations: STRAIGHT and COMBO. The boards are installed according to a layout plan, to create a pre-determined channel for the PEX tubing. Ecowarm® RadiantBoard™ cuts easily with a high tooth carbide tipped circular saw.

STRAIGHT – Used about 60% of the time



SUPERCOMBO – Used about 40% of the time for BYPASS or RETURN needs



ECOWARM® RADIANTBOARD™ features a heavy aluminum layer bonded with a water-based adhesive that contains no-VOC when dry. Our Straight and Combo finished panels measure 47" x 23.5" and are cut from standard 4' x 8' sheets of plywood. 1/2" PEX TUBING is spaced 11.750" on center. One-quarter radius turns measure 5.935" from the edge. Tubing is walked into the grooves in the Straight boards and Combos. See also loop length and precaution guides.



ESTIMATING THE REQUIRED NUMBER OF BOARDS

For simple and fast installation, it is highly recommended that a full Ecowarm® RadiantBoard™ layout be used, indicating the precise panel and tubing layout. This can be provided through Ecowarm™. A full professionally drawn plan is recommended for your first few jobs. Contact us about doing a layout and a design. The following calculations can be used for estimating the required number of boards. For experienced installers, calculate the net heated floor square footage of each room and multiply by the following factors: Straight x 0.0805 Combo x 0.0494 (rule of thumb: 62% of a job requires Straight boards, 38% Combos).

EXAMPLE: A 600 sq. ft. room. Multiply 600 by 0.0805 to get approximately 49 Straight boards, and by 0.0494 to get 30 Combos. We always recommend adding another 5%-10% material excess to your estimation to account for waste. Doing an exact layout will give you the most accurate estimate of boards needed. Large rooms use fewer Combos and more Straights. Small rooms typically use fewer Straights and a larger number of Combos.

ALWAYS PLAN

- *Carefully read and follow the installation instructions.*
- *Familiarize yourself with the materials and installation methods before you start.*
- *Use and follow a CAD layout, particularly if you are a first time RadiantBoard™ installer.*

LOOP LENGTHS

- *Notice that loop lengths should never exceed 350'. For heat loss areas over 25 BTUs/Sq.Ft., loop lengths should not exceed 250'.*
- *Since the tubing is placed 11.75" on center, a 350' loop will cover a maximum of 350 Sq.Ft. A 250' loop will cover a maximum of 250 Sq.Ft.*
- *Remember to allow extra length to reach the manifolds.*

TUBING AND LOOP LENGTHS

Ecowarm® RadiantBoard™ is designed for use with 1/2" nominal ASTM F-876 or F-877 PEX (cross-linked polyethylene), with an average outer diameter measuring 0.625 inch. Loops shall never exceed 350 feet, including sufficient leaders to the manifolds. For areas expecting a heat loss of greater than 25 BTU/Sq.Ft., loops shall never exceed 250 ft. This is due to high pressure drops and water velocity, as shown in Chart C-2 on page 13 (gray/blue area = more than 25 BTU/Sq. Ft). Friction losses in the chart are approximate; actual friction losses depend on fluid viscosity and temperature.

*The shaded area in the 350' loop chart C-2 on page 13 indicates a high pressure drop. It is recommended that you use the shorter 250' loop length in this case, as shown in the lower chart. Once the room square footage is determined, multiply the total by 1. Example: For a 600 Sq.Ft. room, multiplying 600 by 1 gives 600 lineal feet of 1/2" PEX tubing.



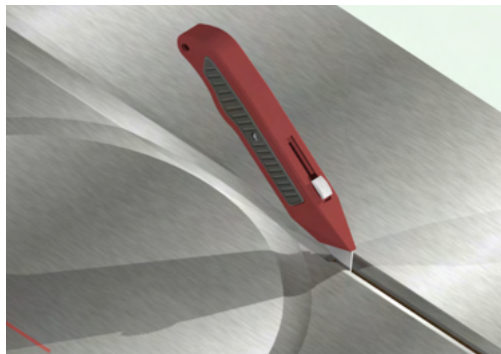
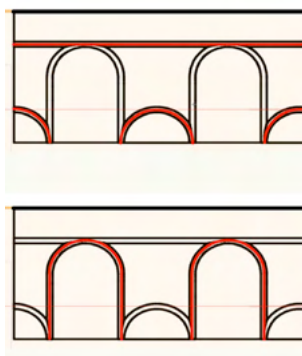
UNDERSTANDING DIFFERENCES BETWEEN COMBOS AND STRAIGHTS

Ecowarm® RadiantBoard™ and Ecowarm® RadiantBoard EPS™ Combos and Straights are made differently for a reason. The board substrate is highly conductive and significantly enhanced by the conductive layer of aluminum that is laminated to the panel.

THE STRAIGHTS: The conductive aluminum layer has aluminum in the grooves and top surface, fully cladding the upper surfaces of the boards. The aluminum over the groove is indented then factory slit and pushed down over the aluminum in the bottom of the grooves. This fits tightly along the side of the tube channels for good contact with the PEX tubing.

THE COMBOS: Combos are laminated and indented at the numerous tubing channels. Only some of the choices of tubing channels are used on any Combo panel. Leaving the aluminum intact over the unused grooves maintains the continuity of lateral heat transfer. To install the PEX tubing into the combo panels:

1. Have a good quality utility knife with a new sharp blade. As an option, use an oscillating tool with a non serrated “scraper blade”. Note if you are purchasing an extra thick aluminum option you will need to use an oscillating tool with a sharp, flat scraper blade.
2. Mark the channels you need to slit.
3. Slit the middle of the tubing channels you are going to use (shown red).
4. Walk the tubing into channels.
5. Use a flat piece of plywood and a rubber mallet to tap tubing in place if necessary.

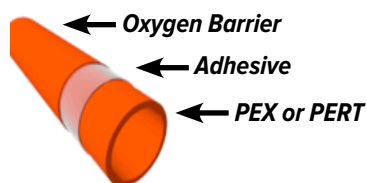


UNDERSTANDING PEX HYDRONIC TUBING

Ecowarm® RadiantBoard™ and Ecowarm® RadiantBoard EPS™ may be used with PEX tubing made by quality manufacturers and manufactured to the appropriate standards. **DO NOT USE PEX/AL/PEX** (pex aluminum pex) since it ovals slightly, will not be retained in the undercut groove, and may protrude above the board due to its ovality.

USE OF OXYGEN BARRIER PEX TUBING

Use of tubing with an oxygen barrier is highly advised to reduce likelihood of corrosion of metal parts in the system. PEX pipe is available with an outer EVOH layer that is the oxygen barrier.



PEX OR PERT WITH **OUTER** OXYGEN BARRIER LAYER

Properly manufactured tubing is a lifetime investment. Buy a quality brand from a company with an established history and warranty in the United States and Canada. PEX Pipe should be certified to ASTM F876, ASTM F877 for use in the USA, and/or CSA B137. 5. for use in Canada.

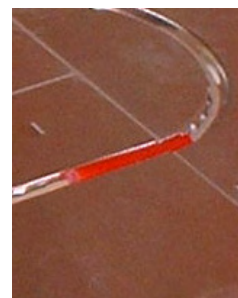
IMPORTANT: FOLLOW LOOP LENGTH RECOMMENDATIONS ON NEXT PAGE!

USE OF NON TOXIC ANTIFREEZE: In climates subject to freezing it is advisable to use non toxic antifreeze to protect pipes from freezing. The most common form of this is Propylene Glycol. Do not use Ethylene Glycol (automotive type antifreeze) since it is very toxic. Buy only premium brands from a knowledgeable supplier who can assist you, provide you test kits for maintenance, and give you good advice about use of corrosion inhibitors if advisable for your system. Remember to calculate the amount of fluid in your system, the total volume of fluid in your heat source, mechanical room piping, supply and return lines including your manifolds, as well as the total amount of fluid in your radiant tubing. Volume of fluid per 100' of 1/2" (.625" OD +/- .004") PEX tubing .92 Gallons per 100'



USE THIS METHOD TO ALIGN THE GROOVES

The easiest way to assure the tubing grooves are fully aligned between boards is to cut 6" pieces of 1/2" ASTM F-876 or -877 PEX to use as alignment tools. Place the boards close to desired alignment, then press a piece of 6" tubing into each groove, lapping 3" into the grooves of each board, as shown. Remove the guides after the boards are attached.



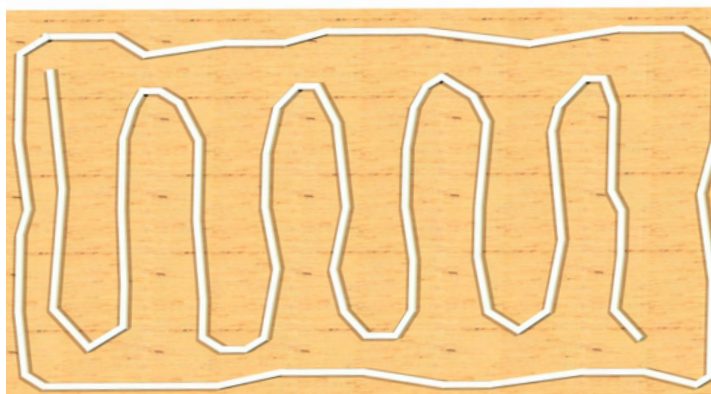
HOW TO ATTACH ECOWARM® RADIANTBOARD™ TO A SUBFLOOR

Each panel should be glued to the wooden sub-floor using low VOC construction adhesive-type glues at a minimum 1/8" bead. Use the gluing pattern shown.

NOTE: Ecowarm® Radiantboard EPS™ has different attachment requirements.

TIPS FOR GLUEING

- *Avoid getting glue in the groove or where it may come into contact with the tubing.*
- *Use only recommended glues. Many glues can damage PEX tubing.*



After gluing and placement, the boards are cross stapled or screwed to the sub-floor.

SCREW OR CROSS STAPLE TO THE SUB-FLOOR

After you have glued Ecowarm® RadiantBoard™ using the proper glue applied in the proper pattern, the boards should then be screwed or cross-stapled to the sub-floor.

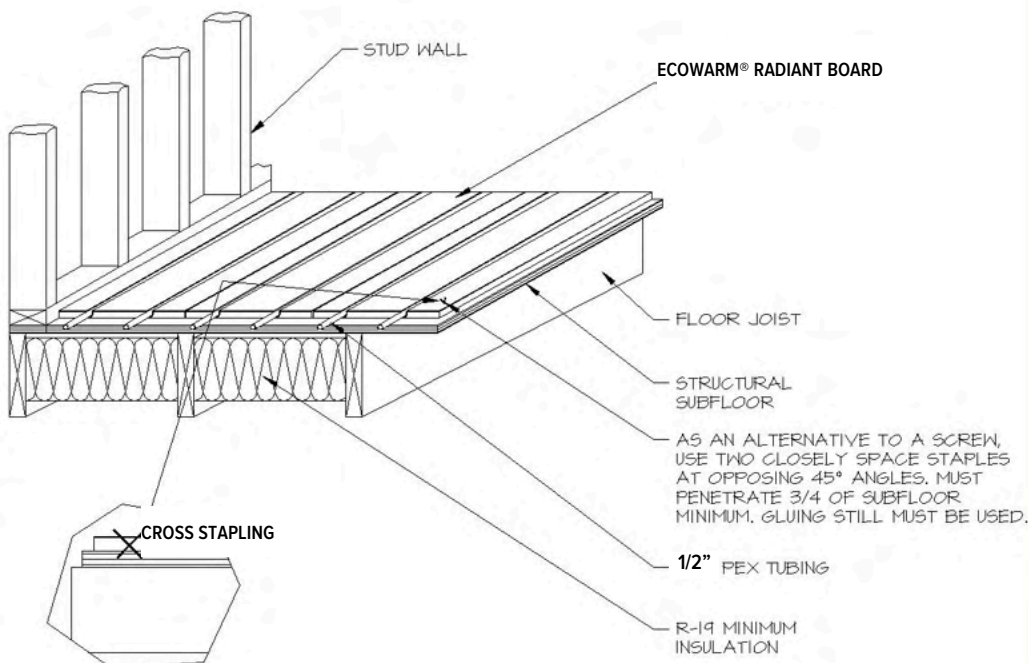
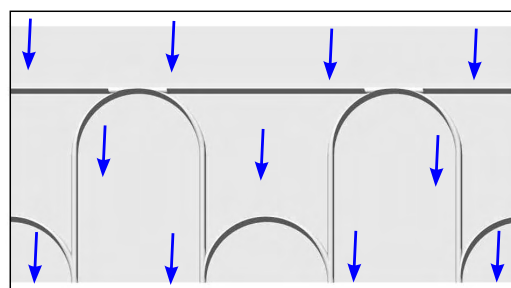
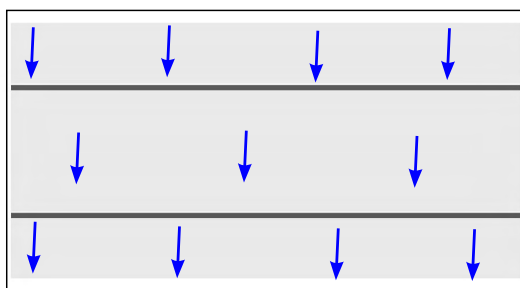


SCREWS: On full size pieces (23.5" x 47"), 11 screws should be used: 8 on the perimeter and 3 in the middle. As a general rule, 12" O.C. for the perimeter, 16" O.C. for the interior. Pattern is shown below.



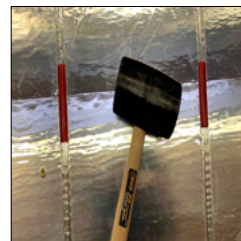
STAPLES: As an alternative to gluing and screwing, Ecowarm® may be installed by gluing and stapling, and then cross stapled as shown for extra strength. Cross stapling means 2 staples are put closely together at opposing 45° angles, as shown below. FOLLOW SEPARATE INSTRUCTIONS ELSEWHERE FOR ECOWARM® RADIANTBOARD EPS™.

Attach Ecowarm® RadiantBoard™ to the sub-floor at locations shown by blue arrows.



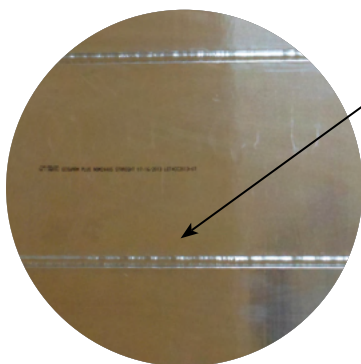
INSTALLING TUBING IN THE CHANNELS

Note: Do not use PERT or PEX-AL-PEX with Ecowarm, use ASTM 876-877 1/2" PEX. When installing over a subfloor: Immediately after glueing the bottom of the boards with construction adhesive (so it has not yet set) and before attaching Ecowarm to subfloor, cut small pieces of the 1/2" PEX pipe to use as alignment strips for the boards. Step or pound them into the boards to align them. Then staple or screw the boards down as shown in the manual.

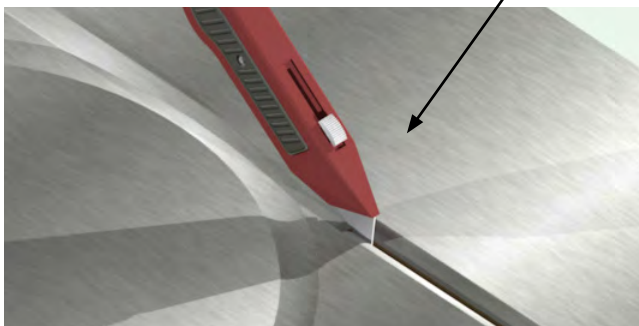
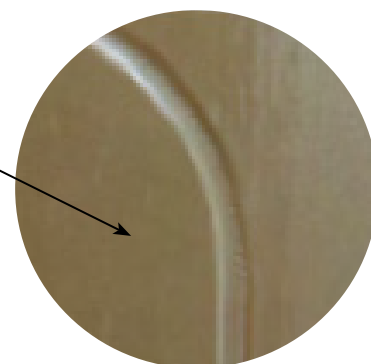


Ecowarm Straights and Combos are made differently for a reason. The Straights are grooved and then aluminum is placed in the channels. The entire top of the board is laminated with aluminum which is then slit and folded over the aluminum in the grooves. Since the Combos have multiple channels to choose from, they are made differently. The combos are first laminated with aluminum, then channels are indented. This keeps the aluminum intact over the channels that are not used. Since aluminum is over 1300 times more conductive than wood, this increases the efficiency of the board. When installing the PEX tubing in the groove, the aluminum splits at the channel and then is pressed against the side of the tube. Thermal imaging has proven it works very well and this value engineering reduces the cost the board to you with negligible reduction of performance.

Tubing is easy to walk in the channels of the straights



When installing tubing, the chosen channels in the Combos must be slit with a sharp utility knife or oscilating tool with a shap flat scraper blade



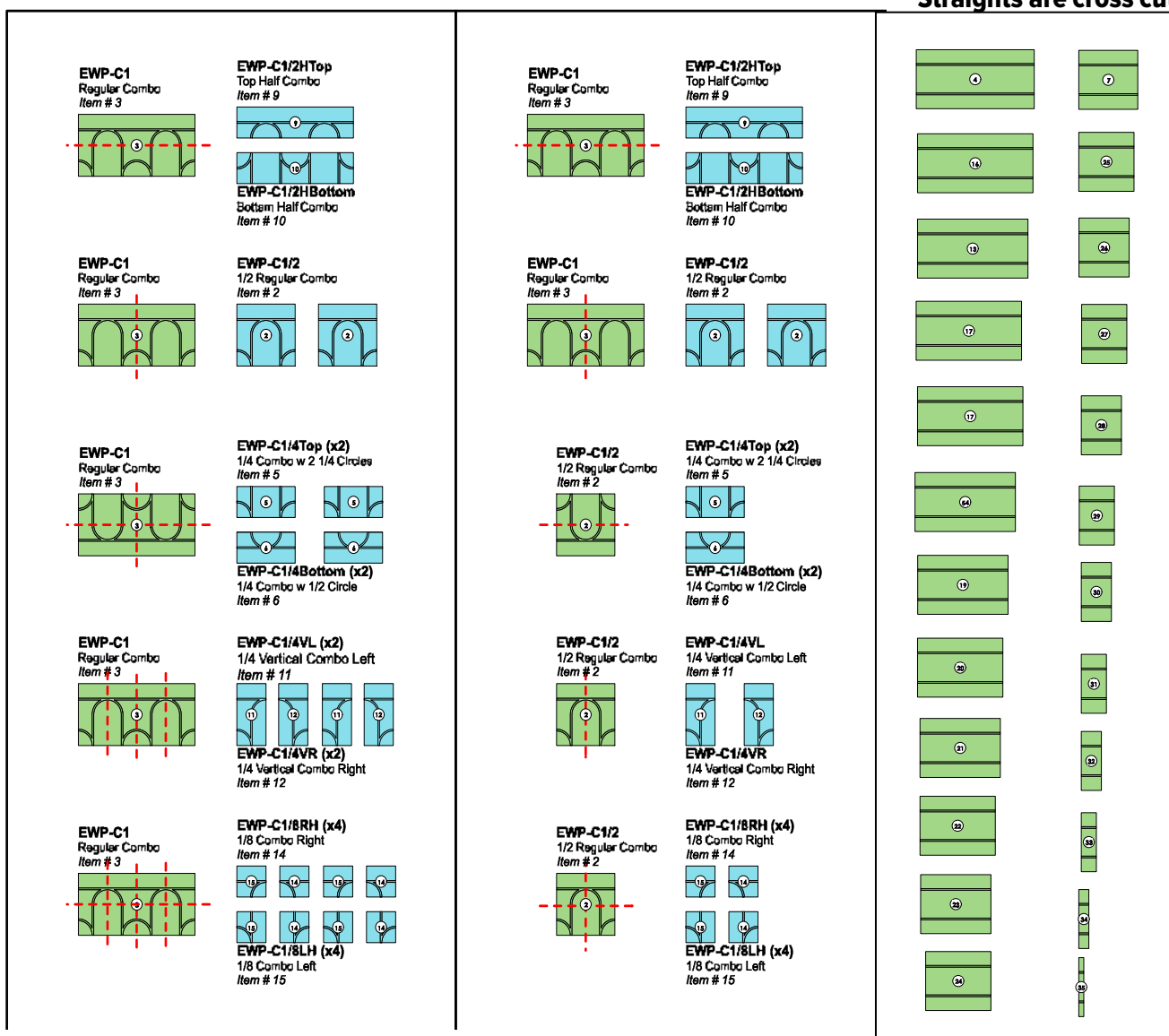
NOTE: If you purchase a new product offering made with OSB and thicker aluminum to be introduced in fall of 2024 you will need to use an oscillating tool with non serrated scraper blade to cut the channels.

CUTTING ECOWARM AND ECOWARM EPS STRAIGHTS AND COMBOS

Ecowarm boards are cut on a router table out of 4'x8' sheets of plywood and lose the kerf of the router and measure 47" x 23.5". They may be easily cut using a high tooth carbide tipped multi purpose blade on a table saw or radial arm saw. They can be cut with a circular saw with a similar high tooth blade but due to the precision of the boards, the more precise cuts of a well adjusted table or radial arm saw is preferred.

On Ecowarm CAD Layouts, a parts list is provided for reference, but cutting is done in the field. Straights are laid out using as many of the full length 47" Combos as possible and the shorter lengths are laid out in 2" increments so actual lengths of the shorter Straight boards should be field verified before cutting. The factory normally includes an extra 5% for waste and errors but it is expected that most of the cut offs will be used so do not discard before project is complete.

Straights are cross cut:



INSTALLATION ESSENTIALS

SHIPPING AND STORAGE

Ecowarm® products shall always be stored in a temperate, dry space between 40°F-90°F. Avoid damp locations and prolonged exposure to sunlight. Follow all instructions in this manual to prevent exposure to moisture. Products are normally shipped by LTL carriers shrink wrapped, banded and with corner protection.

Nominal Dimensions: Each board is 47" x 23.5" x 3/4" thick or 7.68 square feet

Weight: Approximately 2 lbs. per square foot, or 16 lbs. per board

Pallet Size: 4' x 4' x 32" tall (two boards to a row, 37 rows high)

Approximate Pallet Weight: 1280 lbs.

Approx. Truckload Quantity: 17,000 square feet, or 33 pallets / 42,240 lbs.

Pallet Appearance: Shrink-wrapped. Corners protected.

Recommended Product Mix: Straight 60%. Combo 40% (Allow 10% extra for waste, but 5% if laid out by our design service). It is highly recommended all first time installers of our board products use our design service.

ECOWARM® RADIANTBOARD EPS™ SHIPPING

Varies with thickness. See chart on page 13. Pallet Appearance: Shrink-wrapped. Corners Protected. Recommended Product Mix: Same as Above

ECOWARM® RADIANTBOARD EPS™ STORAGE

Always store in a temperate, dry place (40°F— 90°F). Avoid prolonged exposure to sunlight. Do not store in a damp location. Be sure to follow all instructions elsewhere in this manual about protecting the board from any prolonged moisture contact. If these instructions are not followed, board expansion could create undesirable results.

SUB-FLOOR REQUIREMENTS — FLAT, DRY, QUIET, NO OVERMENT OR SQUEAKING

The surface of the subfloor must be flat. This requirement for flatness is defined as the maximum difference between two adjacent high points and the intermediate low point. The maximum acceptable difference in level is 3/16" of an inch in a 10-ft. radius. Fill excessive voids or low areas using a leveling compound. Allow the leveling compound to dry thoroughly before beginning the installation. Check with the leveling compound manufacturer to be sure it is appropriate for the application. High areas can be ground down or floated over with a self-leveling compound. In addition to being flat, the surface of the floor must be clean and dry.

WOOD SUBFLOORS

Wood subfloors must have a stable moisture content, between 6% and 10%. Creaking subfloors must be repaired before installation. If the sub-floor sags, inspect the joists below for twists or weakness. If the subfloor is cupped or uneven at the joints, recheck the moisture content of the subfloor to be sure it's within the 6 – 10% range. Always check the crawl space or basement for excessive moisture and look for any other signs of a potential water problem.



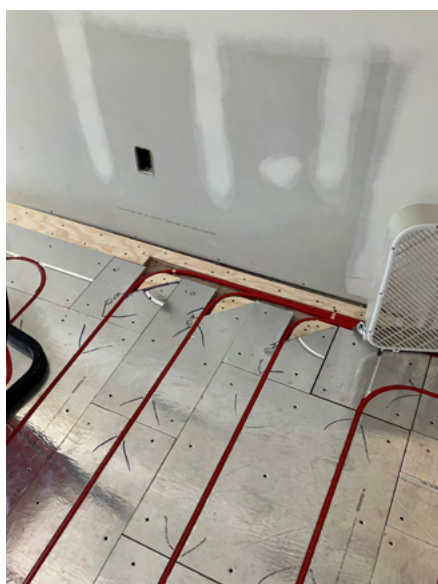
USE THE CORRECT TUBING AND SPACING BOARDS

Ecowarm® RadiantBoard™ has a slightly undercut groove and is designed to use ASTM 876-877 regular 1/2" PEX. Do not use PEX-AL-PEX because it won't rebound into the undercut board, but will remain ovaled and will protrude above the top of the board. NOTE: Please adhere to loop length limitations.



UNDERSTAND HOW TO SPACE THE BOARDS

The actual width of each board is 23.5", which provides for installing the panels with a slight gap between boards. This allows the panel to expand in different temperatures and accounts for normal variances in humidity in a finished home. When aligning Straights with Combo boards, use a 6" piece of tubing as a guide. A slight gap of approximately 1/32" will naturally occur between the Straight boards. This is normal. Try to allow a similar 1/32" inch gap between the ends of all boards, but always make sure all grooves align.



INSTALLER'S NOTE: CUT YOUR BOARDS ACCURATELY

Since Ecowarm® RadiantBoard™ is a modular system, the boards are manufactured to tight tolerances in groove spacing and as to the squareness of the sides and ends. When cutting Ecowarm® Radiant Board, make sure to cut the boards squarely and to carefully align the boards so that subsequent pieces will fit correctly. This is not difficult, but attention to this easy step will prevent major problems. See tips for groove alignment.

High areas on the subfloor should be sanded or planed. Any low areas should be patched or filled with an appropriate leveling compound, or covered with a rigid underlayment. When using a leveling compound, follow the manufacturer recommendations, and allow the compound to dry completely before you begin installing the floor.

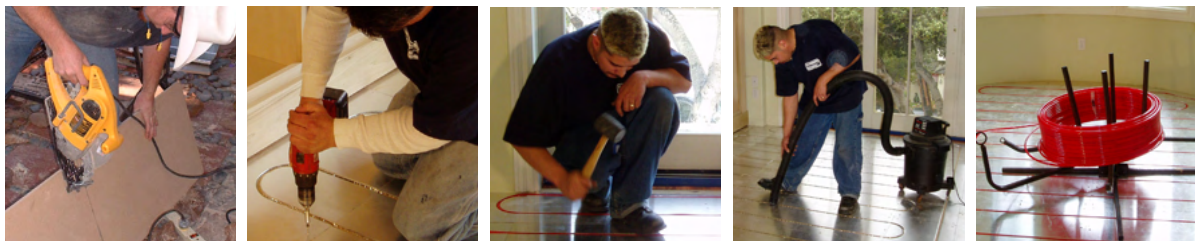
EQUIPMENT FOR INSTALLATION OVER WOOD SUBFLOOR

You'll need the following to install Ecowarm® RadiantBoard EPS™:

- Table or circular saw. A carbide blade with a high tooth count recommended.
- Electric or cordless drill with a No. 2 Phillips bit (if you are screwing down the boards) and a 5/8" drill bit for supply and return bury points.
- Sheathing type pneumatic stapler (if you are cross stapling boards)
- Screws of sufficient length to penetrate sub-floor min.1/2" (if using screws)
- Recommended glue or adhesive
- Rubber or hard hide mallet
- Chalk line, marking pencils, and a square
- Vacuum cleaner to clean grooves prior to installation
- 6" lengths of 1/2" PEX for properly aligning the grooves
- Tubing uncoiler is recommended for installing the tubing

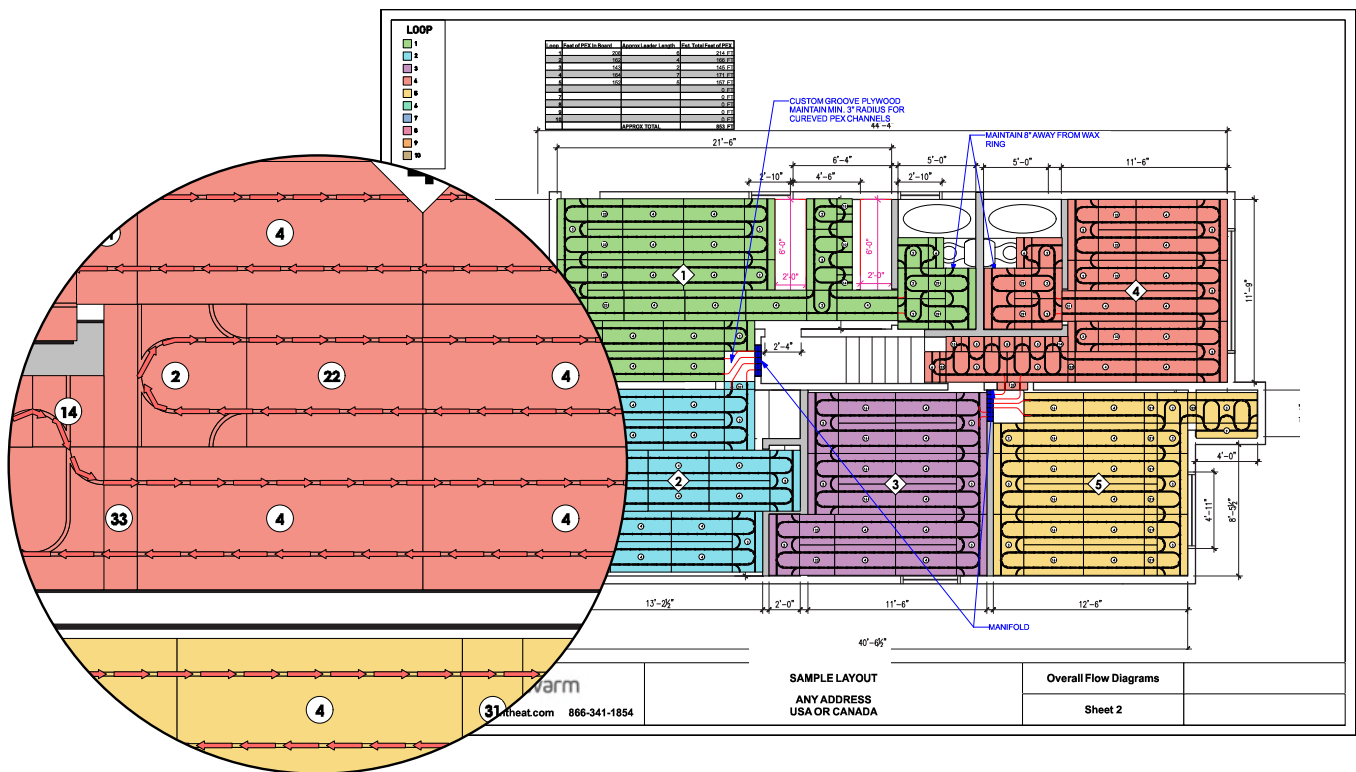
THE BOARD LAYOUT IS KEY

Work from a CAD plan specific to your project for Ecowarm® installation to assure optimum performance. This will properly route heat around built-ins, ensure flow from room to room (hallways can be particularly tricky), allow proper zoning, and assure all loops arrive at your manifold(s) within the loop length guidelines. Piecing together a system can be complex, especially if it's your first project. Your Ecowarm® RadiantBoard™ sales person can help you arrange this design service.



CAD DESIGN & LAYOUT

Ecowarm® offers two levels of design services. Most customers choose a board layout which provides a diagram for board placement. It also includes consulting with the drafter/designer to work out zoning and manifold locations as well loop length chart and a separate drawing with arrows of the tubing routing through the boards. In this case the job plumbing or mechanical contractor will specify the mechanical equipment and run supply and return lines to the manifolds. Below is a sample of a board layout.



NOTE: Tubing pathway arrows show up as drawing is enlarged

For large and complex projects Ecowarm® can offer a complete mechanical design. For these projects we will connect you with the Monterey Energy Group (MEG). Based in California. MEG has more than 20 years of experience in the radiant industry, and having designed more than 3,000 systems across the US and in many parts of the world, MEG has the experience and knowledge to design the optimum operating system per your type of construction. A national leader and independent source of design and consultation, MEG works with homeowners, architects, installation contractors, and manufacturers to design custom heating systems for both residential and commercial buildings.

SYSTEM DESIGN – BENEFITS TO THE OWNER

A professionally designed radiant heating system can save any project money, time and headaches. A system design ensures the optimal function of a new or retrofit installation, providing the most comfortable radiant heating system for your budget. Properly designed and installed, radiant heating systems add value to homes or buildings, while layout plans provide a permanent record of your system if resell or renovate.

BENEFITS TO THE ARCHITECT OR DESIGNER

The ability to offer a “complete heating system design” can be attractive to a client. A professional plan designer can offer expert advice on integrating mechanical systems into the design. They can also suggest which type of system best suits a specific construction type, explore system integration with building controls, and discuss system performance per various climates, floor coverings, ceiling heights, window configurations – even in multi-level, multi-zoned homes and buildings.

BENEFITS TO THE INSTALLER

With a professionally designed layout plan, installation contractors can quickly get material takeoffs for bids. We pre-size all components including 1/2” PEX distribution tubing and exact circuit lengths. Our plans offer balancing data for all circuits in a clear, concise table.

Spend less time on design — focus on Ecowarm™

system installation. A plan designed to ensure proper operation is a good selling feature to prospective clients; an exact design prior to work, and a clear, permanent record of the system.

LAYOUT DESIGN

A standard layout design may include:

- A full size system plan: board and tubing layout, and manifold location(s)
- Separate tubing loop layout, including the lengths of each loop
- Board count of required Ecowarm™ Straights and Supercombos

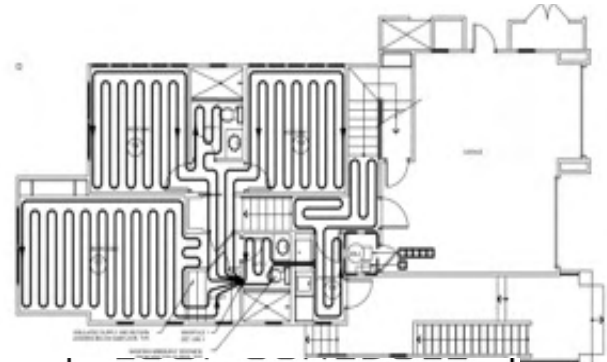
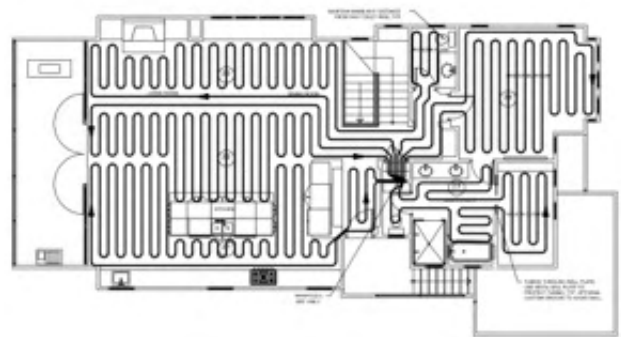
MECHANICAL DESIGN

A complete mechanical design can include:

- System balancing data—a computer simulation report that summarizes zones, flows, water temperatures, and tube lengths. This allows the installer to bid, install, and balance the system for optimal performance.
- Complete component schematic, including specs on heat sources, pumps, valves, manifolds, expansion tank, etc., as well as sizing (length) the distribution tubing.
- Installation notes and details.
- A system controls page with controls schemes.



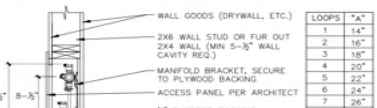
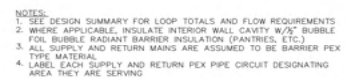
A system design includes a detailed board and loop layout, board count and loop lengths.



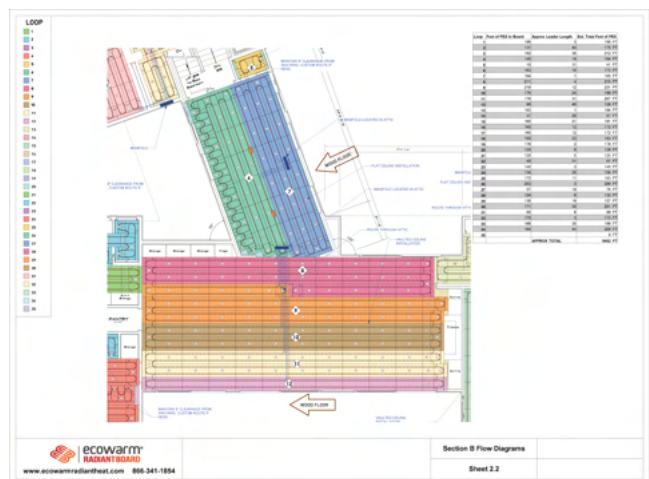
OPS	"A"
1	14"
2	16"
3	18"
4	20"
5	22"
6	24"
7	26"
8	28"
9	30"
10	32"



1 MANIFOLD INSTALLATION- MULTI ZONE MANIFOLD



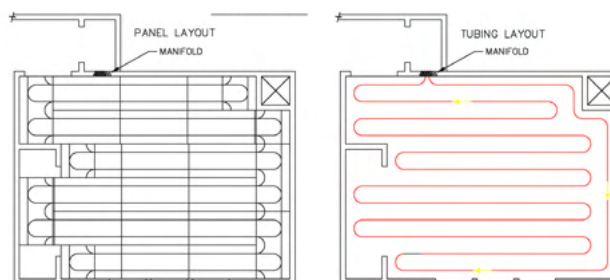
DESIGN SERVICES



EXAMPLE LAYOUT AND INSTALLATION: BOARDS AND TUBING

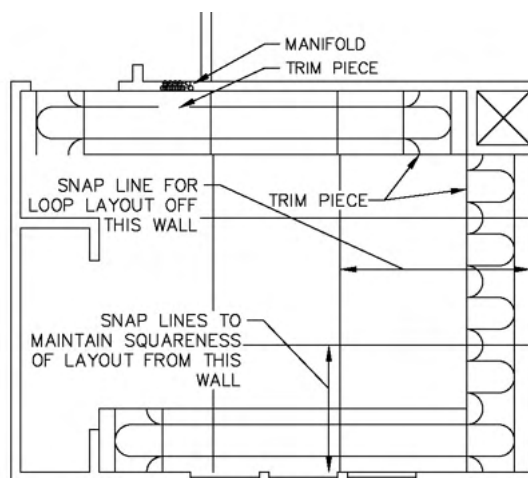
LAYOUT INSTALLATION STEP 1

Look at your layout plan and determine the number and type of boards you'll need and tubing lengths required. Be sure to allow for enough tubing at the ends to serve as leaders up to the manifolds. Then proceed as shown in next steps.



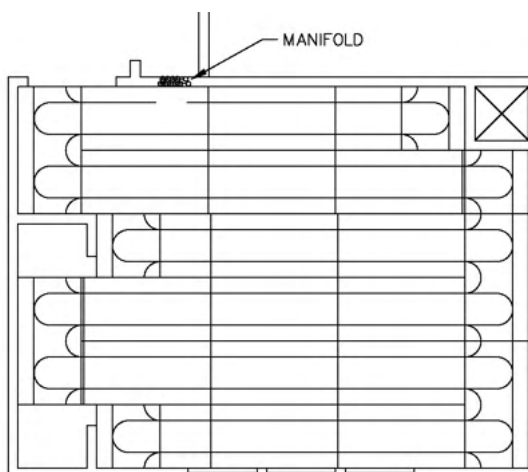
LAYOUT INSTALLATION STEP 2

Begin your Ecowarm® RadiantBoard™ layout by starting the board at the beginning of the supply run into the space, then running boards along the perimeter of the heated space to the area of highest heat loss.



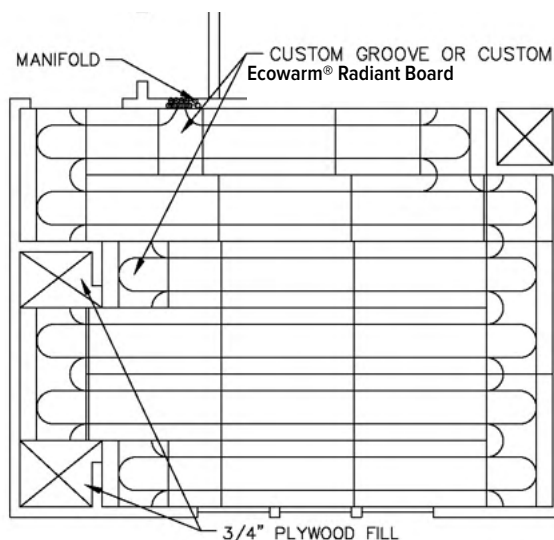
LAYOUT INSTALLATION STEP 3

Add end pieces and straight pieces, working your way back away from the area of highest heat loss. Once all the boards are in place, confirm your tubing route allows for supply and return leaders to the manifold(s). Route the leader to the manifold, either via the existing panels, custom grooves, grout (slab or existing sub-floor application) or by drilling holes into the sub-floor for access.



LAYOUT INSTALLATION STEP 4

Finish laying out your Ecowarm® RadiantBoard™ pieces according to your design layout, and do any special grooving necessary to route the tubing back to the manifold.



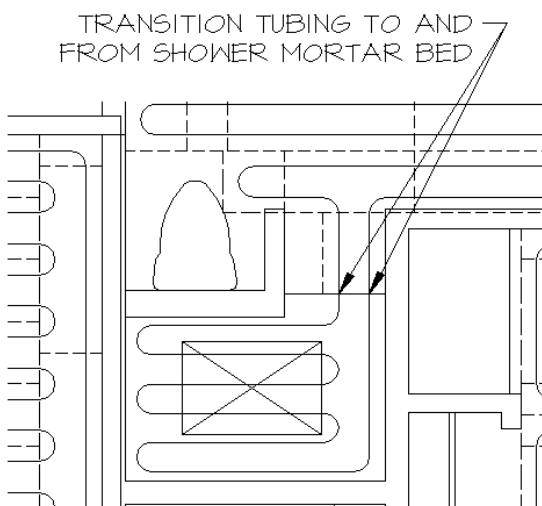
LAYOUT INSTALLATION STEP 5

Feed enough supply tubing to route to your manifold through a drilled supply hole below the floor, or before the start of the groove (if the groove goes directly to the manifold). After every groove has been thoroughly cleaned with a vacuum cleaner, tubing may then be “snapped” into the channel per your layout plan. Once tubing has been routed back to the return location, cut enough tubing to route it to the return manifold.



SPECIAL COVERAGE AREAS

In areas of special coverage, such as shower basins using tile grout as a base, tubing may be routed to and from Ecowarm® RadiantBoard™ in order to accommodate the desired coverage.



FLOOR REQUIREMENTS

THE SURFACE OF THE SUB-FLOOR MUST BE FLAT

The requirement for flatness is defined as the maximum difference between two adjacent high points and the intermediate low point. The maximum acceptable difference in level is 3/16 of an inch in a 10-ft. radius.

FIRST, FILL EXCESSIVE VOIDS OR LOW AREAS USING A LEVELING COMPOUND

High areas can be ground down or floated over with a self-leveling compound. Check with the leveling compound manufacturer to be sure it is appropriate for the application. Allow the leveling compound to dry thoroughly before you begin the installation. The surface of the sub-floor must be clean and dry.

SUB-FLOOR REQUIREMENTS – WOOD SUB-FLOORS

Wood sub-floors must have a stable moisture content, between 6 – 10%. Creaking sub-floors must be repaired before installation. If the sub-floor sags, inspect the joists below for twists or weakness. If the sub-floor is cupped or uneven at the joints, recheck the moisture content of the sub-floor to be sure it is in the 6 – 10% range.

Check for excessive moisture in the crawl space or basement and look for other signs of a potential water problem. High areas are to be sanded or planed; low areas are to be patched or filled with an appropriate leveling compound, or covered with a rigid underlayment. When using a leveling compound, be sure to follow the manufacturer's recommendations, and allow the compound to dry completely before starting to install the floor.

NOTE: See also the specific application drawings and notes for installing Ecowarm® RadiantBoard™ and floor coverings on pages that follow in this manual.

IMPORTANT NOTE: CONCRETE SUB-FLOORS with Ecowarm® Radiant Board

Ecowarm® Radiantboard EPS™ is now the preferred way to install our product over concrete. Ecowarm® RadiantBoard™ was initially designed to be installed over a wood sub-floor. Installation over concrete has been successfully done, but requires extra care and an assured dry slab. Please consult and follow the instructions, limitations and details later in this manual when installing Ecowarm® RadiantBoard™ or the EPS version over concrete.



OVERVIEW AND REASONS TO USE THESE PRODUCTS OVER CONCRETE

Many older and unheated basements have concrete slabs with no insulation under them. Retrofitting them with Ecowarm® RadiantBoard EPS™ can provide an efficient low profile choice. It comes with EPS foam prebonded to it to minimize downward heat loss. There are ways of installing Ecowarm® RadiantBoard™ that does not have an EPS layer as shown in our application drawings but installing Ecowarm™ directly over an uninsulated concrete slab means a higher downward heat loss or if installing over insulation requires extra work and layers.

MOISTURE ISSUES AND CONCRETE

It is important that a concrete slab be dry and stay dry year around. We recommend Adhesives that also act as a moisture barrier but they have a limit to how much vapor pressure they will withstand.

Installation over concrete requires special care due to the difficulties of sealing concrete, moisture issues, and attaching the panels to concrete.

All concrete slabs give off supplementary moisture whether above, on, or below grade. This can cause problems for any board product installed above the slab. Ecowarm® may be installed over concrete using the following three methods only when the installing parties are willing to assume full responsibility for the installation issues regarding moisture and attachment of Ecowarm® to concrete.

When installing Ecowarm® over concrete, moisture considerations must be carefully addressed. Remember that while a slab may appear to be, or actually be, dry during one time of year, this may change as environmental conditions change. Follow this procedure for testing the moisture of slabs, including those between floors, as in commercial construction. It is the contractor's as well as the installer's responsibility to test all concrete substrates, both new and old, for moisture content to determine they are sufficiently dry to install Ecowarm®. Moisture in the concrete should be tested according to ASTM F

1869 (Calcium Chloride Moisture Test using the Quantitative Method). With a calcium chloride test, the maximum acceptable reading is 3 lbs./ 4 hours/ 1,000 Sq. ft. New concrete slabs and basements must be cured for a minimum of 60 days prior to installation. Determine that the existing or new slab is sufficiently dry, and do any sealing of the slab before you proceed with any Ecowarm® RadiantBoard™ installation.

It is strongly recommended that all slabs below grade and slabs on grade be sealed against moisture penetration before installing Ecowarm™ by means of vapor barriers or product that is a sealant and an adhesive. It is also important that all installations of Ecowarm® RadiantBoard™ over concrete slabs below grade and slabs on grade be insulated against downward heat loss either as shown in the detail below or under the slab or downward at the perimeter according to the Radiant Panel Association recommendations.

The increasing use in seismic areas of engineered "Seismic Slabs" means that fewer radiant floor heating systems will be installed with tubing in the slab, and there will be more need for the Ecowarm® RadiantBoard EPS™ details over concrete in the flooring assembly section of this manual.

For recommendations for floor covering assemblies installed over Ecowarm® Layer that is installed over concrete without the EPS layer, refer to details on other pages for additional information and requirements, and refer to the following pages for details of how to install Ecowarm® Radiantboard™ itself over concrete. For example, tile would be installed over Ecowarm® Radiantboard™ with a backer board layer, crack isolation membrane, mortar, etc. as shown on Flooring Assembly pages. When installing Ecowarm® Radiantboard™ itself without the insulating layer provided by Ecowarm® Radiantboard™ layer, it must be installed as according to one of the 3 methods shown on the pages of Flooring Assemblies. Refer to next page for using Ecowarm® Radiantboard EPS™ over concrete with its pre-attached foam layer available in different thicknesses and R-Values.

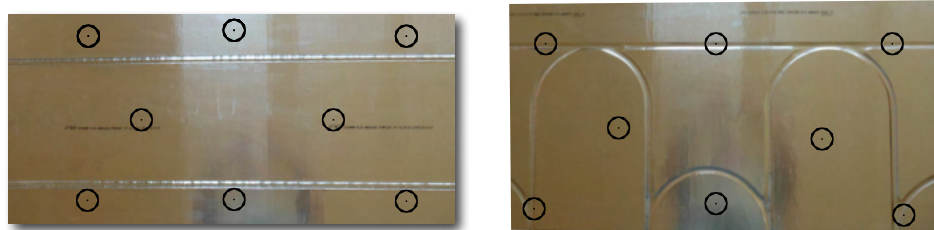
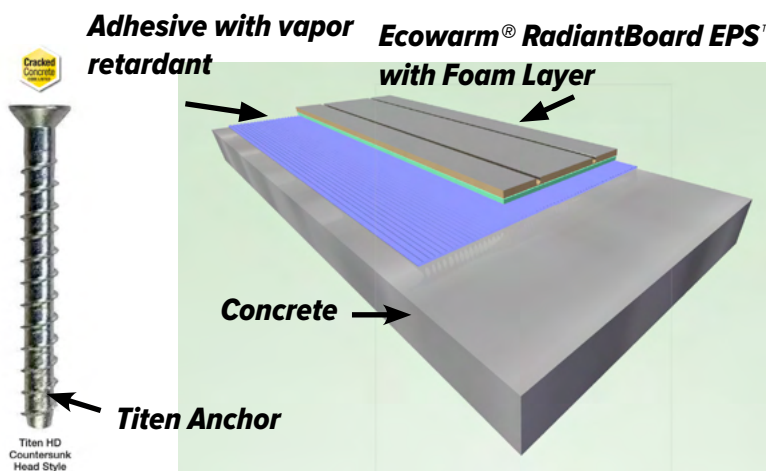


INSTALLING ECOWARM® RADIANTBOARD EPS™ OVER CONCRETE

Ecowarm® RadiantBoard EPS™ should be installed with an approved adhesive with a vapor retarding characteristic after being checked for flatness and tested for moisture content. The contractor shall make a test of the bond of the foam to concrete, and let it cure to confirm there is a good bond to concrete. Extra security for the bond shall be provided by using a minimum of 4 anchors evenly spaced or eight anchors per board in damaged or poorly bonded concrete in the pattern shown below. These anchors also assure that the panels stay in place while the adhesive dries. Cut nails, Tapcons, and Simpson Titen anchors of appropriate length may be used. Of these, cut nails and Titen Anchors seem to be the fastest and preferred by contractors. Titen anchors have carbide infused threads and, with the proper hole size and depth, go in easily and have great holding power. We recommend using Simpson Strong Tie Titen HD Counter Sink head screws because they have carbide treated threads with lower friction. Tapcons or cut nails of similar size may also be used.

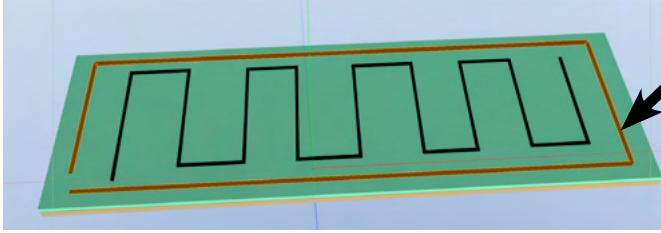
To Use A Titen HD Anchor follow these instructions. Use a drill bit the same diameter as the nominal diameter of the anchor to be installed. Drill the hole to the specified embedment depth plus minimum hole depth over drill (see information below) to allow the thread tapping dust to settle, and blow it clean using compressed air. Alternatively, drill the hole deep enough to accommodate embedment depth and the dust from drilling and tapping. This is usually min 1/2" extra but you

will have to test for right depth. Countersink the hole and then insert the anchor through the panel and into the hole. Tighten the anchor into the concrete until the screw head is flush with the aluminum layer. Use the slowest setting on the impact drill for last portion of setting the anchor. The anchors may only be reduced or eliminated at the full responsibility of the installer and only when the installer has tested that the foam is fully adhered and well bonded to quality concrete. Remember that the anchors increase the bond of the panel to the concrete and also protects them from moving around when walked on while the adhesive is drying.



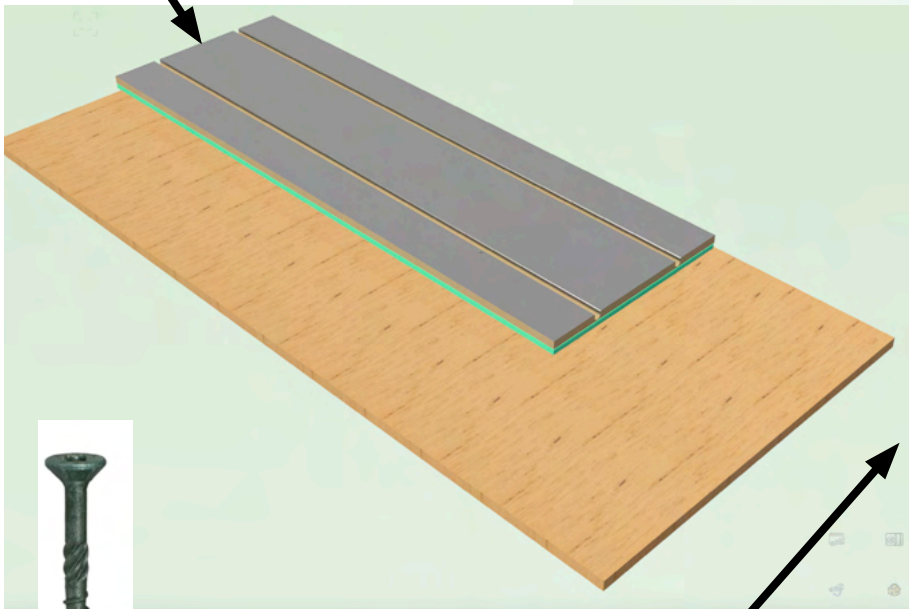
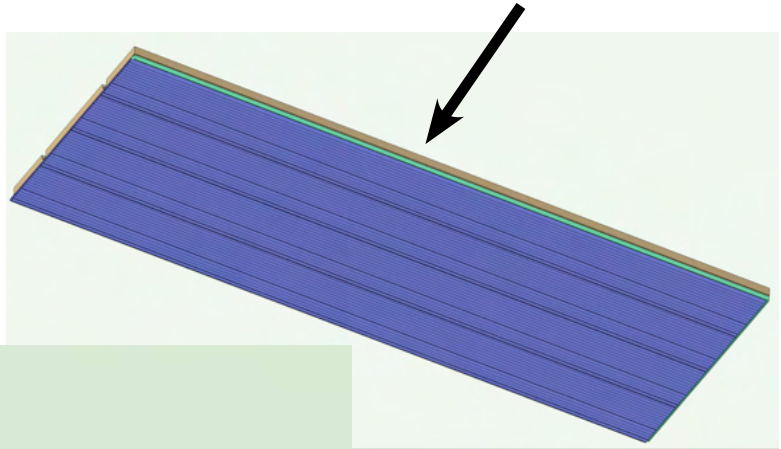
Install 8 anchors per board at the black dot locations as described above.

ATTACHING ECOWARM® RADIANTBOARD EPS™ TO A WOOD SUBFLOOR



To attach Ecowarm® Radiantboard EPS™ to a wood sub-floor, use one of two methods. Either apply to the foam side, a thick 5/16" bead of approved adhesive in the pattern to the left or use a V nottch 1/4" trowel as shown below to coat the backside of each panel.

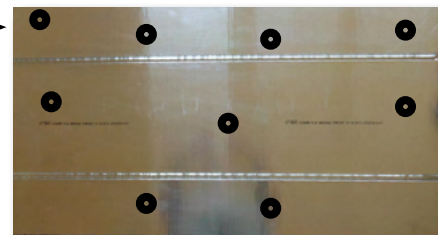
Then firmly press the panels onto the sub-floor and screw down at the ten dotted locations on the boards shown at the bottom right using the minimum length screws shown in the chart below. The screws should penetrate the sub-floor a minimum of 1/2".



Use 11 quality screws of appropriate length in chart below to attach panels to sub-floor. Make sure you penetrate sub-floor a minimum of 1/2". Align panels as you go with short pieces of tubing.

Cautions:

Many adhesives that will bond foam can damage tubing. Use recommended adhesives. Be aware of screw lengths if electrical or plumbing are directly under sub-floor.



DESCRIPTION	THICKNESS	MIN WOOD SCR LENGTH
EPS .375" FOAM	1.125"	1.625"
EPS .05" FOAM	1.25"	1.75"
EPS .75" FOAM	1.5"	2"
EPS 1" FOAM	1.75"	2.25"
EPS 2" FOAM	2.75"	3.25"

EQUIPMENT REQUIRED FOR INSTALLATION OVER A WOOD SUB-FLOOR

The following are necessary for the installation of Ecowarm® RadiantBoard™:

- A table or circular saw. A carbide blade is recommended.
- Caulking gun for 1/8" bead of adhesive.
- Electric or cordless drill gun (if you are screwing down boards) with a No. 2 Phillips bit and 5/8" drill bit for supply and return bury points.
- Sheathing type pneumatic stapler (if you are cross stapling boards).
- Rubber or hard hide mallet – possibly needed to apply tubing to groove.
- Chalk line, marking pencils and a square.
- Vacuum cleaner to clean grooves prior to installation of the tubing.
- Pre-cut 6" pieces of 1/2" PEX for aligning grooves. • A tubing uncoiler is recommended for installing tubing.

INSTALLERS NOTE: CUTTING ECOWARM® RADIANTBOARD

Ecowarm® RadiantBoard™ cuts easily with a quality carbide circular saw blade. Pieces must frequently be cut to provide an accurate fit for each room. It is important that they be cut squarely to keep the alignment of grooves accurate in the installation. If you are cutting a large number of boards for a complicated space, number them and make a map or use a plan so you remember where they go.



INSTALLING TUBING IN THE GROOVES

Vacuum the grooves so there is nothing that will damage the tubing or prevent it from properly going into the groove. The use of a tubing uncoiler is recommended. Start at the intended manifold location and allow enough tubing as a “leader” to attach the tubing to the manifold. Begin laying the tubing, but make sure you understand the layout and where and how you will return to the manifold. There is, intentionally, a tight tolerance between the ASTM F-876 or -877 PEX tube and the slightly undercut groove. This allows the tubing to be retained in the grooves once it is pushed into place. Usually, this only requires “walking” the tubing into the groove, as shown. Occasionally tubing installation may require the use of a rubber or hide mallet to force the tubing into place in the grooves.



After installing a loop of tubing, always walk the entire loop and make sure the tubing is fully seated in the groove for the entire length of the loop. This is very important! The top of the tubing should be just below the level of the top of the Ecowarm® panel and fully retained in the groove.



INSTALLER'S NOTE: ALUMINUM, GROOVES and TUBING

Ecowarm Straight panels are fully clad with aluminum on top and in the grooves. The tubing may be walked into these slightly undercut grooves. Occasionally you may need to use a leather or rubber mallet to fully seat the tubing. The Combo boards are made differently: the aluminum layer is slightly indented and cover the grooves. This allows you to use only those grooves designated in your tubing layout – the remaining aluminum grooves remains intact, allowing it to maintain full conductivity.

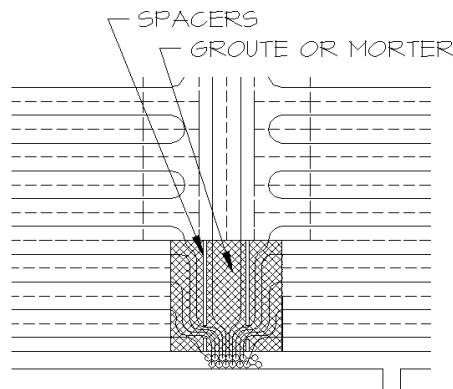
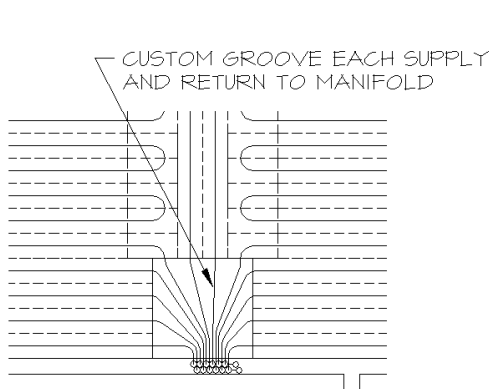
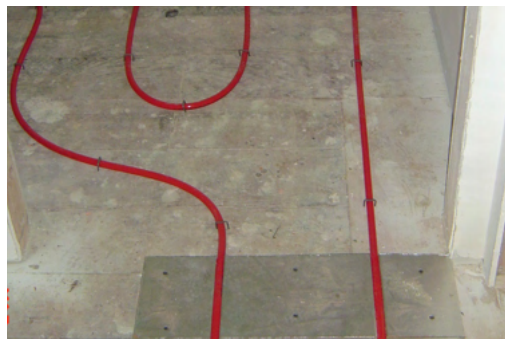
To help align the grooves in adjacent boards, use a 6” piece of tubing as a guide, with 3” in each adjacent panel. Again, when placing tubing in Combo boards, install the tubing by “walking” it into only those channels designated in the system layout plan.

CONNECTIONS AT THE MANIFOLD

Manifolds are usually located near and above the heating zone they serve, in such places as the back of a closet. Route tubing to the manifold in one of four ways:

1. Insert the tubing directly from the grooves: this works when just a few loop ends are adjacent to the manifold location.
2. Drill an access hole, dive and route the tubing under the floor, and bring it back up at the manifold, assuring you've allowed enough leader length of tubing. Be sure to drill the holes more as a slot to avoid over-bending tubing.
3. Place a solid Ecowarm® RadiantBoard™ or plywood sheet next to the manifold into which supply and return lines are custom-routed to the grooves of the Ecowarm® RadiantBoard™.
4. Finally, tubing may be run out of Ecowarm® RadiantBoard™, stapled to the sub-floor, and routed directly to the manifold. Use grout to cover the tubing and level it to the Ecowarm® RadiantBoard™. If needed, sleepers may be placed between the tubing to provide a nailing or screw-in base for the floor coverings. Use nailing plates as necessary to protect tubing from damage.

Depending on how many circuits are included on a given manifold, various sizes of grooved sheets or grouting areas may be required.



ECOWARM® RADIANTBOARD™ INSTALLED OVER WOOD SUBFLOOR

GENERAL INSTALLATION REQUIREMENTS FOR ALL FLOORING OVER WOOD SUB-FLOOR

1. Do not install Ecowarm® RadiantBoard™ without an accurate room-by-room heat loss analysis of the structure to be heated and a design/layout for Ecowarm® RadiantBoard™ that takes into account the resistance and heat transfer of the actual floor coverings. If Ecowarm® RadiantBoard™ cannot provide all the necessary heat, make provisions for additional back up heat.
2. Thoroughly clean all surfaces to which Ecowarm® RadiantBoard™ will be applied. The surface must be flat and dry prior to installation. See requirements for flatness and moisture below. The requirement for flatness is defined as the maximum difference between two adjacent high points and the intermediate low point. The maximum acceptable difference in level is 3/16 of an inch in a 10-ft. radius. Wood sub-floors must have a stable moisture content between 6–10%. Creaking sub-floors must be repaired before installation. If the sub-floor sags inspect the joists below for twists or weakness. If the sub-floor is cupped or uneven at the joints, recheck the moisture content of the sub-floor to be sure it is in the 6–10% range. Check for excessive moisture in the crawl space or basement and look for other signs of a potential water problem. High areas should be sanded or planed, low areas patched or filled with an appropriate leveling compound, or covered with a rigid underlayment. When using a leveling compound, be sure to follow the manufacturer's recommendations and allow the compound to dry completely before starting to install the floor.
3. Chalk lines square for a reference, as walls may be out of square.
4. Lay out boards according to the plan.
5. Secure boards with construction adhesive to the wooden sub-floor. Be sure to use adequate adhesive and follow the recommended pattern.
6. Start layout of all pieces by securing a corner to allow for proper alignment.
7. Use 6" lengths of tubing in the grooves, lapping 3" into each board to help align the grooves of the boards.
8. A 1/32" width space shall be used between boards (or thickness of credit card).
9. After gluing boards in place, drill and screw or cross staple Ecowarm® RadiantBoard™ to the sub-floor according to the recommended pattern.
10. Once all boards are installed, clean out all grooves with a vacuum.
11. Snap tubing into the clean grooves and route to manifold per plan.
12. Follow specific recommendations for each floor covering, and refer to the complete installation manual for further instructions on the installation of an Ecowarm® RadiantBoard™ system.



ATTACHING PANELS TO A CONCRETE SUBFLOOR

Many older, unheated basements have concrete slabs with no insulation. Retrofitting with Ecowarm® Radiantboard EPS™ offers an efficient, low profile choice. The EPS panel includes pre-bonded foam which minimizes downward heat loss. You may still use traditional Ecowarm over un-insulated concrete however a higher downward heat loss may occur and installing over insulation requires extra work and layers.

MOISTURE ISSUES AND CONCRETE

It is important that a concrete slab be dry and stay dry year around. We recommend adhesives that also act as a moisture barrier, but they have a limit to how much vapor pressure they will withstand. Successful installations of Ecowarm® over concrete require special care due to the difficulties of sealing concrete, moisture issues, and attaching Ecowarm™ to concrete.

All concrete slabs give off supplementary moisture whether above, on, or below grade. This can cause problems for any board product installed above concrete. Ecowarm® may be installed over concrete only when the installing parties are willing to assume full responsibility for the installation issues regarding moisture and attachment of Ecowarm™ to concrete. It is the contractors and installers responsibility to test all concrete substrates, both new and old, for moisture content to determine if they are sufficiently dry.

Moisture conditions must be carefully addressed when installing Ecowarm over concrete. Remember that while a slab may appear to be, or actually be, dry during one time of year, this may change as environmental conditions change. Follow this procedure for testing the moisture of slabs, including those between floors as in commercial construction.

MOISTURE TESTING

Moisture in the concrete should be tested according to ASTM F 1869 (Calcium Chloride Moisture Test using the Quantitative Method). With a calcium chloride test, the maximum acceptable reading is 3 lbs./ 4 hours/ 1,000 Sq. ft. New concrete slabs and basements must be cured for a minimum of 60 days

prior to installation. Ensure the new or existing slab is sufficiently dry and finish sealing the slab before proceeding with the Ecowarm™ installation.

It is strongly recommended that all slabs *below grade* and slabs *on grade* are sealed against moisture penetration before installation of Ecowarm using vapor barriers or a sealant and adhesive product. It is also important to insulated against downward heat loss under the slab or downward at the perimeter according to the Radiant Panel Association recommendations.



The increasing use in seismic areas of engineered “Seismic Slabs” means that fewer radiant floor heating systems will be installed with tubing in the slab. There will be more need for the Ecowarm® Radiantboard EPS™ details and the *3 Ways to Install Regular Ecowarm® Radiantboard™ Over Concrete* details.

When installing traditional Ecowarm® without the insulating EPS layer refer to the details shown in this manual. Refer to the Flooring Goods section for more details regarding individual floor types such as tile or hardwood.

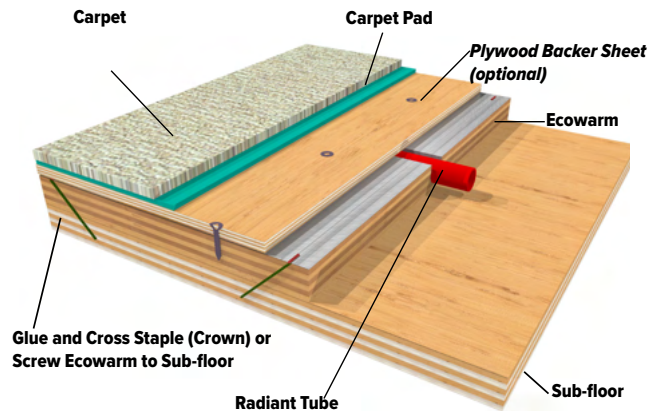
FLOOR COVERINGS

CARPET OVER ECOWARM® RADIANTBOARD™

Ecowarm® RadiantBoard™ shall be installed over a wooden sub-floor in compliance with *General Installation Requirements For All Flooring Over Wood Subfloor*.

In addition, the following specific precautions and instructions shall be followed:

Carpet and pad may be installed over Ecowarm® RadiantBoard™. When installing the pad, care should be taken to avoid puncturing tubing. As with all radiant heating installations, to allow for adequate heat transfer, a thin slab foam rubber pad and short, high density carpet should be used. If the carpet pad is glued, first install the optional plywood backer sheet, since removal of the bonded pad in the future may damage and compromise the aluminum layer. Maintain a 2" minimum tubing clearance from carpet tack strips. While optional, it is advised that a thin layer of underlayment plywood be applied over Ecowarm® RadiantBoard™ prior to carpet and pad installation to protect the tubing from point loads such as a piano. Without this thin underlayment, thin carpet and pad may eventually show striping where the tubing is and, while less likely, tubing may be vulnerable to puncture from sharp cleats, golf shoes etc.



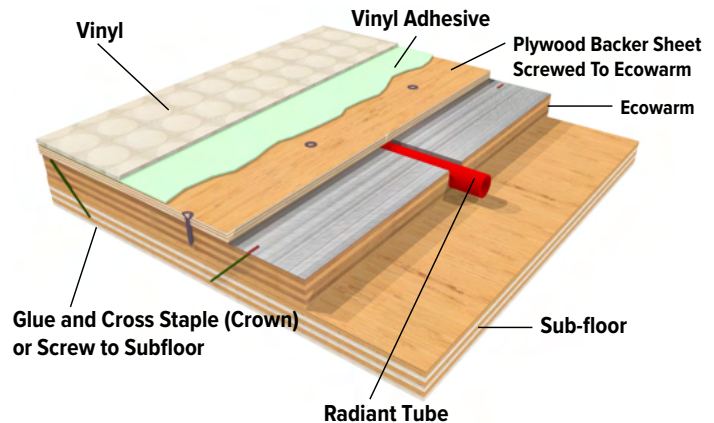
USE THE SAME ASSEMBLIES FOR ECOWARM® RADIANTBOARD EPS™

VINYL OVER ECOWARM® RADIANT BOARD

Ecowarm® RadiantBoard™ shall be installed over a wooden sub-floor in compliance with *General Installation Requirements For All Flooring Over Wood Subfloor*.

In addition, the following specific precautions and instructions shall be followed: When installing vinyl flooring, we require that a thin layer of underlayment plywood be applied over Ecowarm® Radiant Board.

In wet locations, a sealant layer should also be added. Underlayment plywood with a grid printed on it helps locate tubing runs and prevent puncturing of the tubing when the plywood is being screwed to the Ecowarm® Radiant Board. In the case of vinyl, use underlayment, filler and glues suggested by the manufacturer for use over radiant heat. Most vinyl flooring is manufactured to an ASTM standard with an upper limit of floor temperatures of 85°F. This limit should be followed. Attach required underlayment with care to not puncture tubing.



USE THE SAME ASSEMBLIES FOR ECOWARM® RADIANTBOARD EPS™



THINSET TILE OR STONE OVER ECOWARM® RADIANTBOARD

Ecowarm® RadiantBoard™ shall be installed over a wooden sub-floor, complying with “General Ecowarm® Installation Requirements For All Flooring Over Wood Sub-floor”. In addition, the following specific precautions and instructions shall be followed: When installing masonry, tile or stone, backer board shall be used over Ecowarm®. Thinset and screw the backerboard to the Ecowarm® with a thinset compatible with PEX tubing. Thinset installation on top of backerboard shall follow the Tile Council of America (TCA) Guidelines. In the kitchen, baths, laundry or any other area where water may be present, a water sealant layer (i.e. Nobleseal) shall be used. Where tile or stone is going to be thin-set, anti-fracture membrane (Nobleseal) or equivalent shall be installed over the backerboard. Maintain 2” minimum tubing clearance when screwing backer board down. Refer to the complete installation manual for further instructions on the installation of an Ecowarm® system.

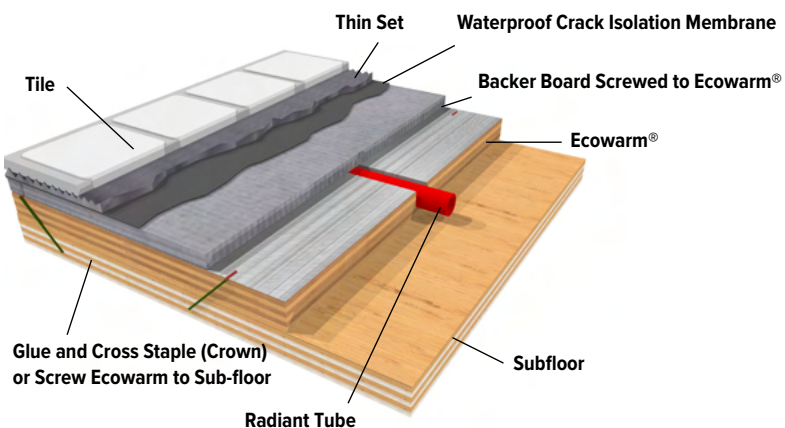
USE THE SAME ASSEMBLIES FOR ECOWARM® RADIANTBOARD EPS™

NOTES ON SEALING

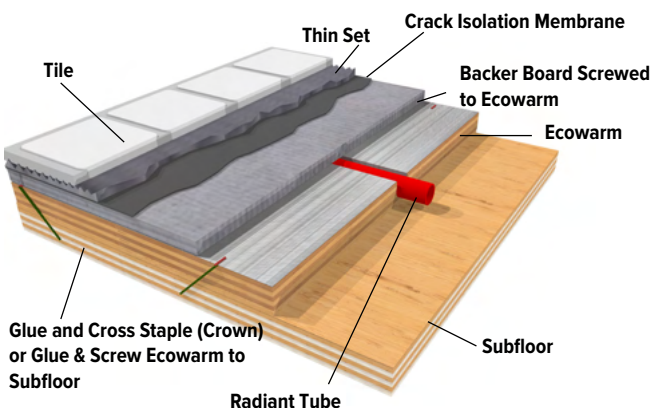
The aluminum layer on top of each panel is highly water resistant. A significant degree of moisture protection is provided simply by using a silicon sealant as a caulk between the boards. Properly applied, this will profoundly reduce the likelihood of water transmission into the boards.

This is not a substitute for our recommended installation methods in wet areas.

THINSET TILE OR STONE for areas *likely* to be subject to moisture



THINSET TILE OR STONE for areas *unlikely* to be subject to moisture



INSTALLER'S CAUTIONS :

Do not omit the backerboard layer. Do not thinset tile or stone directly to Ecowarm® Radiant Board™. Do not install crack isolation membranes directly to Ecowarm® RadiantBoard™ – they may not get a good bond and many use materials incompatible for contact with PEX.



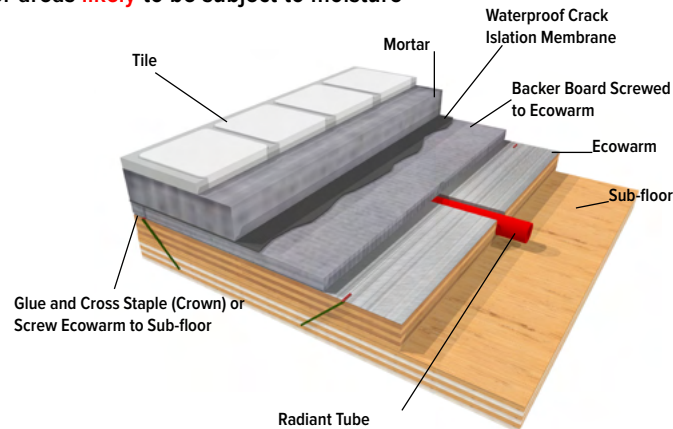
MORTAR BED SETTING OF TILE OR STONE OVER ECOWARM® RADIANTBOARD

Ecowarm® RadiantBoard™ shall be installed over a wooden subfloor in compliance with *General Installation Requirements For All Flooring Over Wood Subfloor*. When installing masonry, tile, and stone, backer board shall be used over Ecowarm® RadiantBoard™. Thin set and screw the backer-board to the panel with thinsets compatible with PEX Pipe. The installation on top of the backer-board shall follow TCA Guidelines. A conventional mortar bed shall then be used. In the kitchen, bath, laundry or any other area where water may be present, a water sealant (i.e. Nobleseal) shall be used. Maintain 2" minimum tubing clearance when screwing backer board down. Refer to the complete installation manual for further instructions on the installation of the Ecowarm® RadiantBoard™ system.

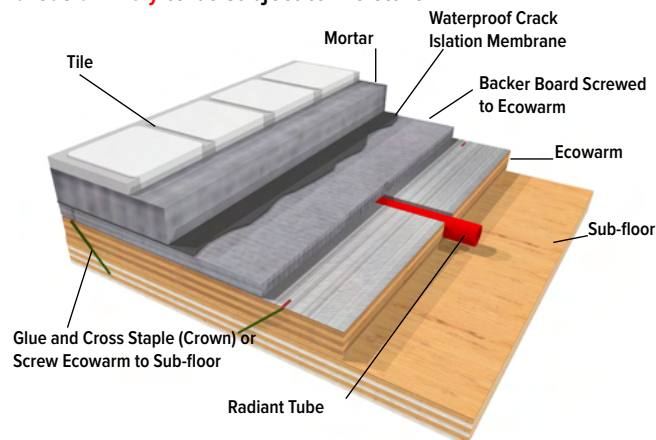
NOTES ON SEALING

- The aluminum layer of each Ecowarm® Radiant Board™ is highly water resistant. Using silicon sealant to caulk between boards gives significant moisture protection. Properly applied, this reduces the likelihood of water transmission into the boards.
- This is not a substitute for our recommended installation methods in wet areas.

TRADITIONAL MORTAR SET TILE OR STONE for areas **likely** to be subject to moisture



TRADITIONAL MORTAR SET TILE OR STONE for areas **unlikely** to be subject to moisture



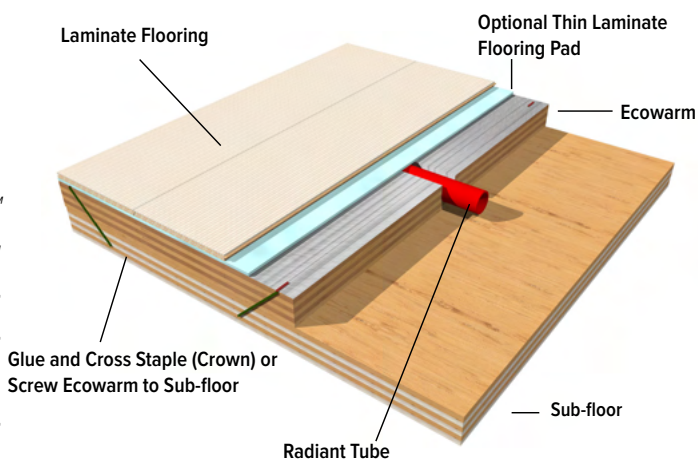
INSTALLER'S CAUTIONS :

Do not install crack isolation membranes directly to Ecowarm® RadiantBoard™ – they may not get a good bond and many use materials incompatible for contact with PEX.

LAMINATE OVER ECOWARM® RADIANTBOARD™

Ecowarm® RadiantBoard™ shall be installed over a wooden sub-floor, complying with *General Ecowarm® RadiantBoard™ Installation Requirements For All Flooring Over Wood Subfloor*. In addition, the following specific precautions and instructions shall be followed: When installing laminate flooring, a thin layer of underlayment plywood may optionally be applied over Ecowarm® RadiantBoard™. In wet

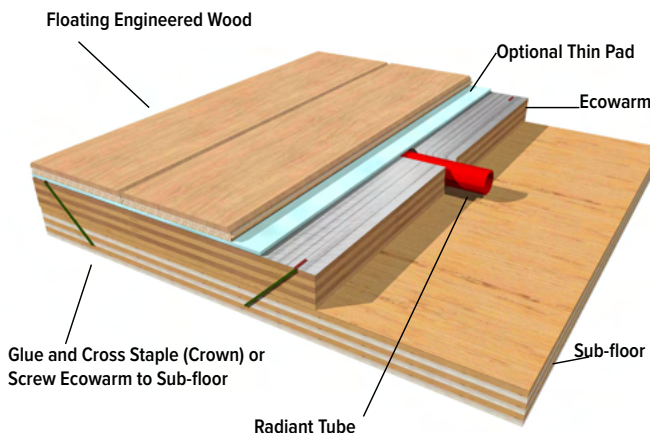
locations, a sealant layer should be added over an underlayment layer of plywood. Many, but not all, laminate flooring products are suitable and recommended by the manufacturer for use with radiant floor heat. Check before installing. Many laminate flooring products have floor temperature limits that need to be observed as well. Install laminate flooring crosswise to Ecowarm® RadiantBoard™ if possible. It is recommended that laminate flooring installed over Ecowarm® RadiantBoard™ shall employ controls that gradually adjust water temperature going to the Ecowarm® RadiantBoard™ with a reset curve. A floor temperature limiting sensor can be used to



ENGINEERED WOOD OVER ECOWARM® RADIANTBOARD™

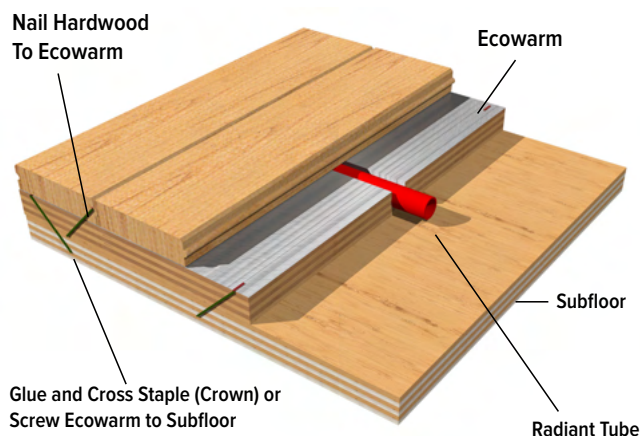
Ecowarm® RadiantBoard™ shall be installed over a wooden sub-floor, complying with “General Ecowarm® RadiantBoard™ Installation Requirements For All Flooring Over Wood Sub-floor”. In addition, the following specific precautions and instructions shall be followed: Many, but not all, engineered wood flooring products are suitable and recommended by the manufacturer for use with radiant floor heat. Check before installing. Many engineered wood floor-

ing products have floor temperature limits that need to be observed as well. Install engineered wood flooring crosswise to Ecowarm® RadiantBoard™ whenever possible. It is recommended that engineered wood flooring installed over Ecowarm® RadiantBoard™ shall employ controls that gradually adjust water temperature going to the Ecowarm® RadiantBoard™ with a reset curve. A floor temperature limiting sensor can be used to comply with the flooring manufacturer’s flooring temperature specifications.



USE THE SAME ASSEMBLIES FOR ECOWARM® RADIANTBOARD EPS™

TRADITIONAL HARDWOOD INSTALLED DIRECTLY OVER ECOWARM® RADIANT



A conventional nailed hardwood floor may be installed directly over Ecowarm® RadiantBoard™ using nails long enough to penetrate the subfloor, and with the utilization of recommended setback controls.

See also sections on general considerations with the use of traditional wood flooring. Ecowarm® RadiantBoard™ shall be installed over a wood sub-floor complying with *General Ecowarm® RadiantBoard™ Installation Requirements For All Flooring Over Wood Sub-floor*.

The following specific cautions and instructions shall be followed:

1. Extreme care shall be taken to avoid nailing tubing.
2. Hardwood floor joints shall not be installed directly at a joint of Ecowarm® Radiant Board.
3. Hardwood floor nails shall be long enough to penetrate both hardwood and sub-floor.
4. Hardwood floors installed directly over Ecowarm® RadiantBoard™ shall employ controls with a reset curve that will gradually adjust the water temperature going to Ecowarm® RadiantBoard™; the floor will expand and contract gradually with temperature changes. This will reduce the likelihood of warping, gapping or shrinkage problems. The use of a floor temperature limiting sensor is recommended.
5. It is extremely important that the designer know the desired installed direction of wood strip flooring prior to the design of Ecowarm® RadiantBoard™ system, since the direction of Ecowarm® RadiantBoard™ should run perpendicular to the direction of the strip flooring.
6. Install strip wood flooring with mallet driven nails of sufficient length to penetrate Ecowarm® RadiantBoard™.
7. Structure humidity shall be kept within the range specified by the flooring manufacturer.
8. The wood flooring shall be installed at the relative humidity recommended by the manufacturer for the local climate where the structure is located.
9. The use of narrower 2" to 3 1/2" strips of wood flooring is recommended over radiant floors, not wide planks.
10. The lessons of local practice and climate shall be referenced.
11. Make sure the heating system has been running and the space has been maintained to at least 65F° long enough that temperature and humidity have stabilized to predicted future levels before installing hardwood flooring over Ecowarm® RadiantBoard™.

USE THE SAME ASSEMBLY FOR ECOWARM® RADIANTBOARD EPS™



CONSIDERATIONS FOR STRIP WOOD FLOORING OVER ECOWARM®

The key to installing wood floors over radiant heat is to give extra care to the species of wood you choose, wood strip width and thickness, ambient moisture levels, installation practices, the heat output requirements of your system, and radiant heating controls.

BOARD WIDTH / DEPTH: Install narrow board widths, preferably 3 inches or less. Avoid boards wider than 4 inches. Narrow boards provide more gaps for expansion and contraction across a floor; therefore, any gaps resulting from natural movement are much less noticeable. The maximum recommended board depth is 3/4 inch. Thicker boards add too much resistance to heat transfer.

DIMENSIONAL STABILITY: Use quarter sawn wood. It is significantly more dimensionally stable than wood that is plain sawn. Pick a wood known to be dimensionally stable. American cherry, ash, most softwoods and teak fill this bill, and oak is reasonably stable. By contrast, hickory, maple, madrone and American beech are known to be less stable.

AGE & DRYING OF TROPICAL WOODS: If you are importing tropical or exotic woods, pay close attention to the source, age and how the wood has been dried. Tropical wood needs to dry slowly to maintain its integrity upon installation. Quick drying creates stresses that can affect the wood later as it expands and contracts. If your supplier has stored the wood in your region with no problems for one to two years, the wood is much less likely to present surprise stress-related problems. Though it can be fun to be unique, please avoid pioneering the use of a wood for which little is known about its dimensional stability.

MOISTURE: Wood naturally expands and contracts in response to changes in moisture. With this in mind, avoid installing wood flooring during such stages of construction as sheet rocking or painting, when significant moisture may be introduced into a structure. Before installation, operate the heating system until the humidity in the structure stabilizes to the average level expected for the area in which the wood floor will be installed. Then, allow the wood to acclimate to this humidity level by “sticking” (usually several weeks) before installation. Sticking is an old term for stacking wood on slats so it can breathe at each layer. This will minimize dimensional changes due to moisture. Make sure the wood is dry, since radiant heat itself can be drying, experienced flooring installers recommend buying wood for flooring over radiant at around 6 to 8 percent moisture content. This figure may change somewhat regionally. Use a moisture meter during the construction process, and then use the average of many readings. Remember, the average expected humidity level of a structure is an average of seasonal conditions. So if the structure is expected to average 30 percent humidity in the winter and 50 percent in the summer, the average would be 40 percent. This equates to about a 7.5 percent moisture content in the wood. Most installers consider this average the ideal moisture level at which to install wood flooring. These numbers can vary significantly by region.

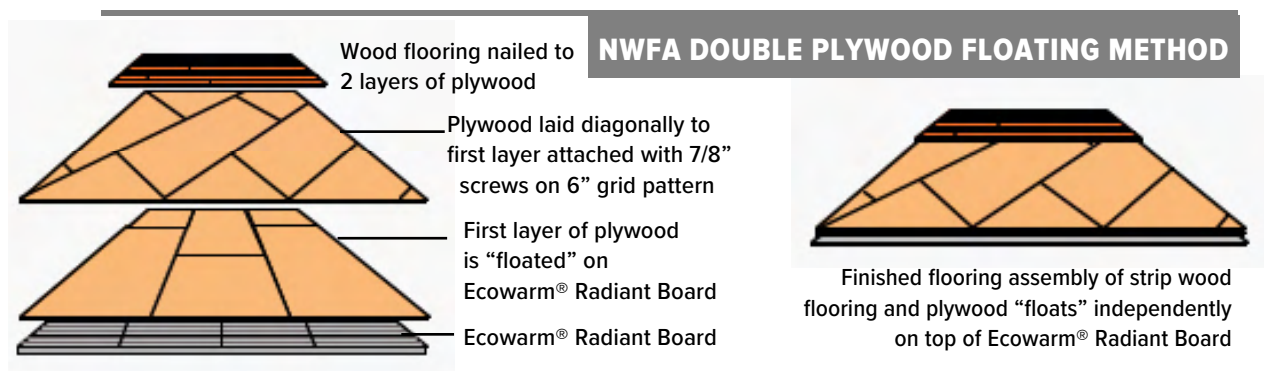
SURFACE TEMPERATURE: The maximum surface temperature of a wood floor should be limited to 85°F. Use a control strategy that ensures this will not be exceeded. Use an indoor or outdoor reset control that gradually brings the floors to temperature.

INSTALLING WOOD FLOORS OVER ECOWARM® RADIANTBOARD™

A conventional nailed and hardwood type system may be used directly over Ecowarm® RadiantBoard™, with controls as described in the previous section. There are many advantages to this method: quicker response, lower cost of installation, higher heat output due to lower resistance of flooring, and an indoor or outdoor reset control that gently brings the flooring through temperature changes – evenly, gradually and accurately.

Optional floating methods for use with traditional STRIP WOOD flooring: two layers of 1/2-inch plywood may be floated on top of Ecowarm® RadiantBoard™ and strip flooring then nailed to it, as shown below in a method recommended by the National Wood

Flooring Association (NWFA). This method has the advantage that it allows the wood flooring system to float independently from Ecowarm® RadiantBoard™, but it also has significant disadvantages in that the additional 1" thickness of plywood limits the output of the system. For example, two layers of 1/2" plywood with 3/4" of strip oak flooring has an R-value of about R-2.3 compared to R-1.55 without. This limits heat output and requires higher water temperatures. Before choosing this system, do a careful heat loss analysis to see if this method will produce enough heat. We recommend a hydronic control strategy with a reset curve that gradually adjusts water temperature going to Ecowarm® Radiant Board™.



Clip style floating strip flooring systems must be installed directly over Ecowarm® RadiantBoard™ such that clips will never come into contact with the tubing. Click Lock style is preferred over clip. The use of a floating engineered wood is a preferred method. This product should have a specific warranty for use over radiant floors. Many manufacturers of these products have such a warranty, and often have extensive experience both in Europe and North America with radiant heating applications. Edge glued floating engineered wood flooring systems are preferred since they are dimensionally stable and expand inde-

pendently from any thermal mass. Ecowarm® RadiantBoard™ should be installed such that the hardwood runs perpendicular to the majority of the tubing runs.

Glue and nail down and *glue down* wood flooring systems require care and correct glue. When using *glue down* and *glue and nail down* methods, the wood floor should be attached to the Ecowarm® RadiantBoard™ according to the flooring and glue manufacturers' recommendations for installation over radiant heat. Check under adhesives elsewhere in this manual and make sure to use an adhesive that is compatible with PEX pipe.

GLUE AND NAIL / GLUE DOWN – WOOD FLOORING SYSTEMS

There has been a recent increase in the use of glue with wood flooring of all types, an increase in wide plank engineered wood flooring that recommends installation with glue and nails, and wood flooring that recommends or allows for installation by glue down methods. This text addresses these changes, recommends several glues to use when wood flooring is installed over Ecowarm® RadiantBoard™ with glue, and highlights concerns and limitations that should be considered.

GENERAL CONSIDERATIONS

Great efforts have been made to make Ecowarm as “green” as possible, and this applies to our glues as well. We use low VOC (Volatile Organic Compound) glues to bond the aluminum to our plywood, and our aluminum is additionally a positive barrier to out-gassing from the glue and the plywood. Since wood flooring glues used to bond flooring to Ecowarm are applied on top of our aluminum, they have the potential to significantly affect the indoor air quality of a room. There is a new generation of more environmentally benign adhesives which substantially reduce these possible emissions, and we recommend their use when gluing down a floor. But consumers should be made aware that traditional nail down methods, edge glued floating engineered wood flooring and floating

edge lock flooring, have, in general, less likelihood of affecting indoor air quality and can be a great choice. Traditionally, in all homes and those with radiant heated floors, wide boards have presented more problems in terms of contraction and expansion than narrow boards; narrow boards allow more small spaces for expansion and contraction from changes in humidity and temperature. Use of wide plank engineered wood floors, or stabilized reclaimed wide plank wood, requires the sophisticated manufacturing of a well stabilized product, and should be carefully researched before use over radiant heat. Wide plank boards are best glued and nailed, and wide plank flooring of species known to expand and contract significantly with changes in humidity should be avoided. Wood flooring installers are advised to discuss these issues with their clients.

ADDITIONAL CONSIDERATIONS

Any wood flooring glue used needs to be compatible with PEX pipe. Due to our board’s aluminum layer, glues dry significantly slower than when applied on a wood sub-floor, See section 3.07 in Recommended Associated Products section for a list of glues that are compatible with PEX pipe for glueing wood floors down to Ecowarm®.

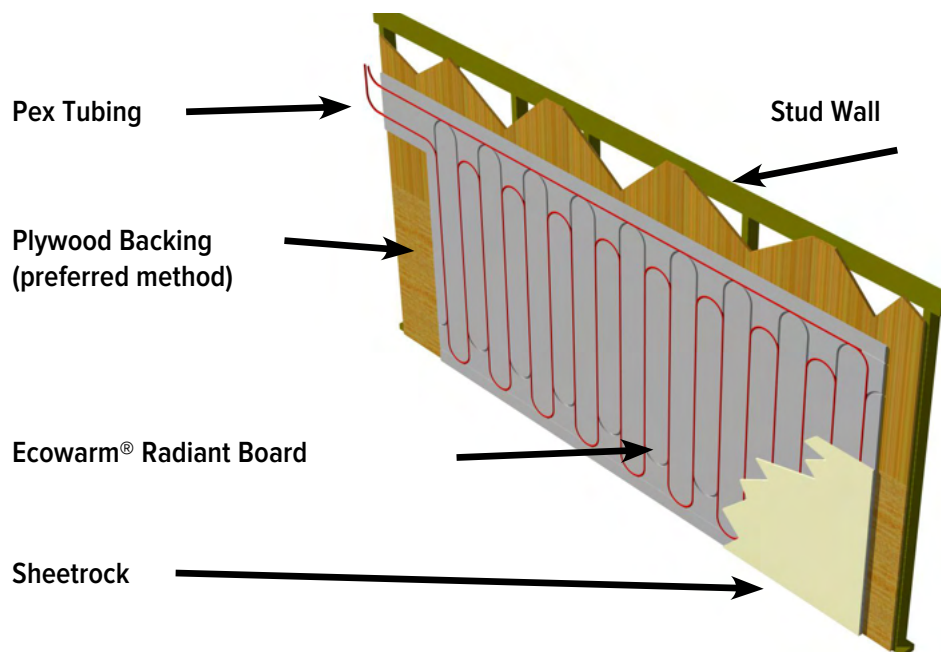
INSTALLER’S NOTE : USE ONLY APPROVED GLUES

Using glues that have not been approved could damage PEX pipe and may not bond well to aluminum.

WALL OR CEILING APPLICATIONS

Ecowarm® RadiantBoard™ may be installed on walls or ceilings to provide extra heat output when floors cannot provide all the necessary heat. Radiant walls and ceilings may also be used to provide all the heat of a room under certain circumstances when properly designed. The heat output of radiant walls and ceilings is different from that from floors, due to differences in the strength of the convective component of the heat, which is stronger in radiant floor heating than in walls or ceilings. However, since walls and ceilings are typically covered only with relatively low R-value 1/2" sheetrock, and acceptable surface temperatures are higher, the heat output of these systems can be quite substantial. It is very important not to overheat sheetrock, or discoloration or damage may occur. For design purposes, use chart C-1 on page 12, but correct the output in BTU's downward 14% for walls and 22% for ceilings. This is because the convective component of the heat output is lower in wall and ceiling radiant heating systems. Ecowarm® RadiantBoard™ wall and ceiling systems shall be installed

as follows. As with flooring, pre-plan your layout. Ecowarm® RadiantBoard™ shall be installed square to framing, and attached to plywood applied to framing (preferred method), or directly to studs, rafters and/or blocking, with as many joints as possible screwed securely to the framing. Ecowarm® RadiantBoard™ shall be secured to plywood or framing on both sides of the grooves on every board. Layout of all pieces shall be started by securing a corner to allow for proper alignment. 6" lengths of tubing shall be temporarily placed in the grooves, lapping 3" into each board as guides, to help align the grooves of the boards during installation. Once all boards are installed, all grooves shall be cleaned out with a vacuum just prior to tubing installation. Tubing shall be snapped into the grooves and routed to a manifold per the plan. A 1" minimum tubing clearance shall be maintained for all nailing. Add steel plate protectors over tubing where tubing crosses studs. Supply water temperatures shall not exceed 120F° when Ecowarm® RadiantBoard™ is installed under plaster or sheetrock.



USE THE SAME ASSEMBLY FOR ECOWARM® RADIANTBOARD EPS™

ECOWARM® RADIANTBOARD EPS™ OVER CONCRETE ILLUSTRATIONS

Ecowarm® Radiantboard EPS™ is the recommended product for installing radiant heat over un-insulated concrete. It streamlines the installation process over un-insulated concrete. Unless your existing slab is already insulated, we recommend Ecowarm® Radiantboard EPS™ as the superior and preferable product to use over concrete.

When installing traditional nail down wood flooring to Ecowarm® Radiantboard EPS™ the nails should penetrate into the EPS but should not hit concrete.

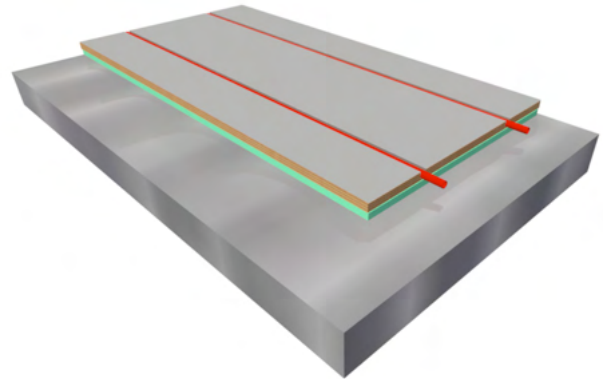


Illustration 1: Ecowarm® Radiantboard EPS™ installed over concrete subfloor

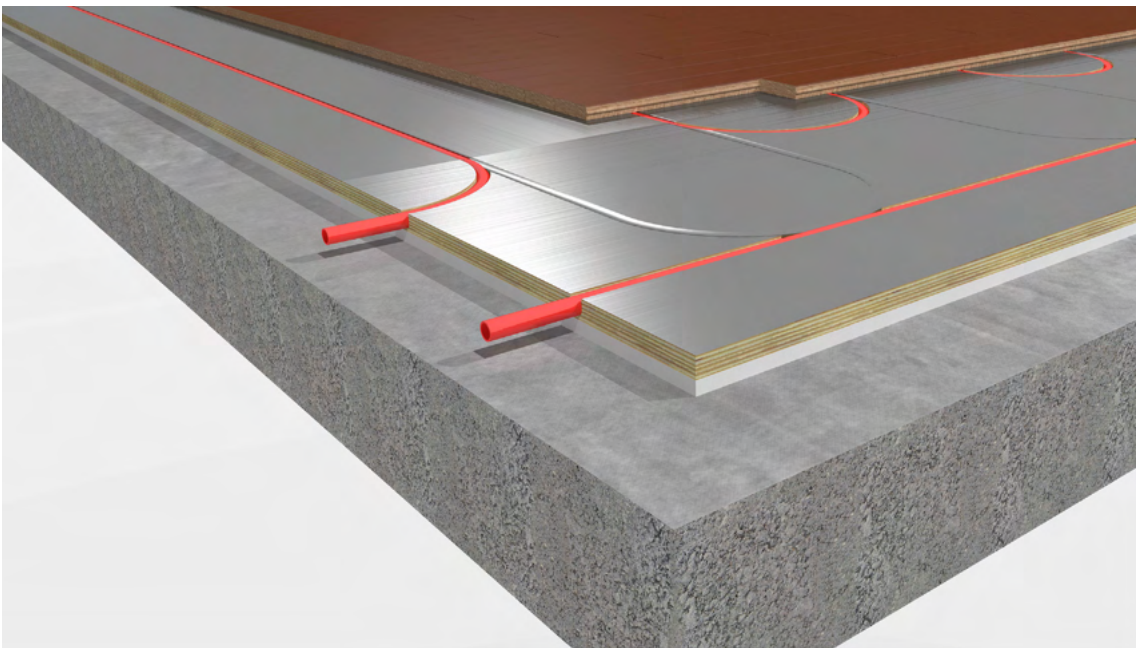
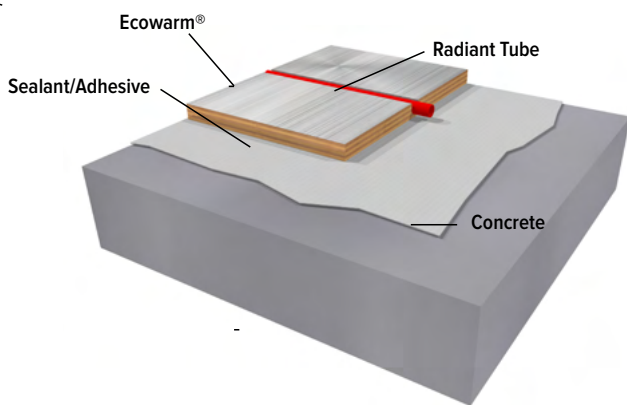


Illustration 2: Ecowarm® Radiantboard EPS™ installed over concrete subfloor

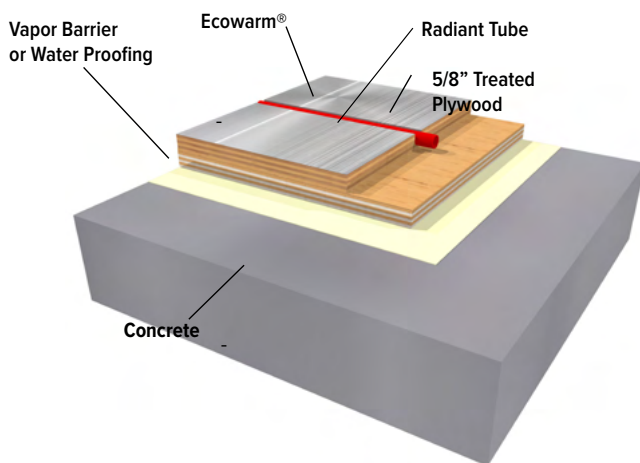
3 WAYS TO ATTACH OR FLOAT REGULAR ECOWARM® OVER CONCRETE

NOTE: ECOWARM® RADIANTBOARD EPS™ is often the best choice over un-insulated concrete, not methods shown below. Method 1 below is a good choice over insulated concrete. Its use over un-insulated has the advantage of thinness but will result in significantly higher downward heatloss. Methods 2 and 3 below allow traditional hardwood flooring nails to penetrate through the Ecowarm® and 1/2" into plywood which is preferred by many flooring installers and manufacturers.



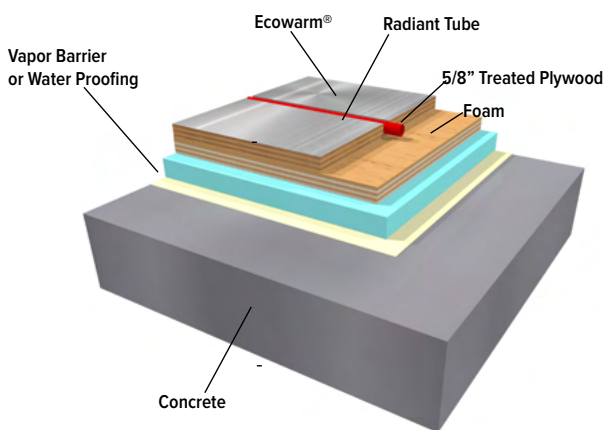
ECOWARM® RADIANTBOARD™ BONDED TO CONCRETE USING SEALANT AND ADHESIVE

Ecowarm® RadiantBoard™ may be installed directly over concrete slabs only when the contractor has verified that moisture conditions will be adequately controlled by the use of a sealant on the slab or a vapor barrier under the slab. When using a sealant and adhesive on top of the slab, the sealant may be a combination sealant/wood adhesive, such as Sika-T35, or the sealant and adhesive may be two separate but compatible products.



ECOWARM® RADIANTBOARD™ OVER PLYWOOD AND VAPOR BARRIER OR WATER-PROOFING

Ecowarm® RadiantBoard™ may be installed on 5/8" T&G treated plywood with a vapor barrier or waterproofing over concrete slabs, only when the contractor has verified that moisture conditions will be adequately controlled by the use of a sealant on the slab or by a vapor barrier over or under the slab.



ECOWARM® RADIANTBOARD™ OVER PLYWOOD, WITH FOAM INSULATION AND VAPOR BARRIER OR WATERPROOFING

Ecowarm® RadiantBoard™ may be installed on 5/8" T&G treated plywood, over foam and with a vapor barrier or waterproofing over concrete slabs, only when the contractor has verified that moisture conditions will be adequately controlled by the use of a sealant on the slab or a vapor barrier over or under the slab.

CHECKLIST — INSTALLING ECOWARM® OVER CONCRETE

FOR ALL REGULAR FLOORING GOODS EXCEPT STRIP WOOD FLOORING

NOTE: Ecowarm® Radiantboard EPS™ is the recommended product for installing radiant heat over un-insulated concrete. It streamlines the installation process over un-insulated concrete. Unless your existing slab is already insulated, we recommend Ecowarm EPS is the superior and preferable product to use over concrete.

Installation shall comply with one of the installation methods and installing parties must accept responsibility for and understand all cautions regarding moisture and attachment of Ecowarm™ to concrete and should refer to the complete installation manual for further instructions on the installation of the Ecowarm™ system. Do not install without an accurate room-by-room heat loss analysis for the structure to be heated as well as a design/layout that takes into account the resistance and heat transfer of the actual floor coverings.

1. Thoroughly clean and level all surfaces.
2. Prevent moisture penetration through slab either by sealing concrete with a vapor sealant or adhesive with integral moisture retardant such as Bostik Green Force per manufacturer's guidelines. A continuous unperforated under slab vapor barrier or above slab vapor barrier as shown on page 35 are also acceptable.
3. Follow one of the details in this manual, chalking lines on floor as reference points and lay out boards according to plan.
4. If glueing to concrete sealed with a sealant be sure to use adequate adhesive compatible with vapor sealant to glue down to the membrane. See preferences for using Ecowarm EPS™ on page 34.
5. When attaching Ecowarm™ to plywood, lay out boards according to plan and glue and screw or glue and cross staple Ecowarm™ to plywood. Be sure to use adequate adhesive.
6. Start layout of all pieces by securing a corner to allow for proper alignment.
7. Use 6" lengths of tubing in the grooves lapping 3" into each board to help align the grooves of the boards.
8. Clean out all grooves with a vacuum prior to tubing installation.
9. Snap tubing into groove and route to manifold per plan.
10. Install backer board when applying tile or vinyl floor goods.
11. Maintain 2" minimum tubing clearance from carpet tack strips or other nailing.
12. Refer to previous drawings for additional details and requirement of flooring goods.



ECOWARM® RADIANTBOARD™ OVER CONCRETE WITH STRIP WOOD FLOORING

Installation shall comply with one of the details on previous pages involving the use of 5/8" treated T&G plywood. Installing parties must accept responsibility for, and understand, all precautions on regarding moisture and attachment of Ecowarm® RadiantBoard™ to concrete, and should refer to this complete Installation Manual for further instructions on the installation of Ecowarm® RadiantBoard™ systems. Do not install Ecowarm® RadiantBoard™ without an accurate room-by-room heat loss analysis for the structure to be heated, as well as a design/layout for Ecowarm® RadiantBoard™ that takes into account the resistance and heat transfer of the actual floor coverings. If Ecowarm® RadiantBoard™ cannot provide all the necessary heat, make provisions for additional backup heat.

AS AN ALTERNATIVE: Consider Using Ecowarm® Radiantboard EPS™

1. Thoroughly clean and level all surfaces where Ecowarm® RadiantBoard™ will be applied.
2. Prevent moisture penetration from under the slab, either by sealing concrete with a vapor retarding adhesive as recommended and approved adhesives and glues elsewhere in this manual or, per the manufacturer guidelines, or with a continuous unperforated under-slab or above-slab vapor barrier.
3. Follow one of the two details that use 5/8" T&G treated plywood under the Ecowarm® Radiant Board, OR AS AN OPTION USE ECOWARM® RADIANTBOARD EPS™.
4. Chalk lines of a square reference point, as construction of walls may be inconsistent.
5. Lay out the boards according to your plan.
6. To allow for proper alignment, start your layout of all pieces by securing a corner.
7. To help align the grooves of adjacent boards, use 6" lengths of tubing as a guide, lapping 3" of the tubing into each board.
8. Glue and screw or glue and staple Ecowarm® RadiantBoard™ to plywood. Be sure to use adequate adhesive.
9. Once all boards are installed, clean grooves with a vacuum just prior to tubing installation.
10. Snap tubing into the designated grooves to route it to the manifold per plan.
11. Install strip flooring with mallet driven nails that penetrate the Ecowarm® RadiantBoard, with care not to puncture tubing.
12. Insulating foam under plywood may be used instead of plywood alone, as shown other pages
13. Hardwood floors installed directly over Ecowarm® RadiantBoard™ shall employ indoor or outdoor reset controls that gradually adjust the water temperature going to the floor.
14. The wood flooring shall be installed at the relative humidity recommended by the manufacturer for the climate involved.
15. Structure humidity shall be kept within the range specified by the flooring manufacturer.
16. Use narrower 2"-3 1/2" hardwood strips over radiant floors, not wider plank flooring.
17. The lessons of local practices and climate shall be referenced.
18. Make sure the heating system has been running and the space has been maintained at a minimum of 65°F for a period long enough that the enclosed structure's temperature and humidity have stabilized to predicted future levels.
19. The flooring product shall be allowed to acclimatize before installation.
20. If you are installing Ecowarm® Radiantboard EPS™ over concrete be sure to follow the specific details for installing this product.



ECOWARM SPECIFICATIONS

ECOWARM® RADIANTBOARD™ AND ECOWARM® RADIANTBOARD EPS™

MODULAR NON-STRUCTURAL RADIANTBOARD™ SYSTEM

PART 1 – GENERAL

1.01 General

- A. Provide all labor, materials, transportation, equipment and services to install an Ecowarm® RadiantBoard™ non-structural modular board system, as indicated by the contract documents and these specifications
- B. Examine all contract documents for instructions, terms and conditions related to the installation of Ecowarm® RadiantBoard™ non-structural system. Provide all work as described and required and support and accommodation of related work.

1.02 References

- A. Radiant Professionals Alliance Guidelines for the Design and Installation of Radiant Heating Systems, applicable portions of sections 16.2 and 19.3
- B. SFI (Sustainable Forestry Initiative Inc.) certification (substrata board supplier used in the manufacture of Ecowarm)
- C. American Society For Testing Materials (ASTM) Standard Specification For Cross Linked Polyethylene (PEX) Tubing
- D. International Building Code (IBC)
- E. Uniform Building Code (UBC)
- F. Uniform Mechanical Code (UMC)
- G. Applicable local modifications and codes that apply in a project's jurisdiction

1.03 Submittals

- A. Verification of SFI certification substrata board supplier used in manufacture of Ecowarm® Radiant Board if applicable
- B. Verification of compliance with RPA Standard Guidelines or local code requirements for heating system design sufficient to supply heating needs of the structure or portion of heating needs as specified by contract documents.
- C. Installation plan showing modular board and tubing layout, manifold locations, installation notes and other system components shall be submitted for approval as specified under the terms and conditions of the Contract Documents. No installation work shall be initiated before such approval is obtained.

1.04 Delivery, Storage, Handling And Quality Control

- A. The General Contractor and, if different, the receiving sub-contractor, owner or agent shall ensure that the Ecowarm modular boards are received in good condition and installed without damage and installed in accordance with construction documents, the then current Ecowarm Installation Manual and applicable code.
- B. The Ecowarm board shall be stored indoors in a temperate (40°F-90°F), dry location. Avoid prolonged exposure to sunlight. Do not store in a damp location. Be sure to follow all instructions in the Ecowarm® Installation Manual on protecting the board from prolonged moisture contact.
- C. PEX tubing before and after installation shall be protected from prolonged exposure to UV light, according to the tubing manufacturer's requirements.

1.05 Site Conditions Required for Installation of Ecowarm® RadiantBoard

- D. Ecowarm shall only be installed on a sub-floor, indoors, in enclosed dry structures.
- E. The surface of the sub-floor must be flat: The requirement for flatness is defined as the maximum difference between two adjacent high points and the intermediate low point.
- F. The maximum acceptable difference in level is 3/16 of an inch in a 10-ft. radius.
- G. Wood sub-floors must have a stable moisture content, between 6 – 10%. Creaking sub-floors must be repaired before installation.
- H. When installing Ecowarm® RadiantBoard™ over concrete, it is the contractor's – as well as the installer's – responsibility to test all concrete substrates, both new and old, for moisture content to determine whether they are sufficiently dry to install Ecowarm RadiantBoard™. Moisture in the concrete should be tested according to ASTM F 1869 (Calcium Chloride Moisture Test using the Quantitative Method). With a calcium chloride test, the maximum acceptable reading is 3 lbs. / 4 hours / 1,000 sq.ft. New concrete slabs and basements must be cured for a minimum of 60 days prior to installation.

1.06 Limited Warranty

Ecowarm warrants that its non-structural modular board products are free from defects in material and workmanship in the manufacturing process when shipped from the factory. For the life of the original sub-floor, any boards determined to have been defective when they left the factory will be replaced by a like number of boards as the exclusive remedy. To qualify for warranty, goods must be inspected upon receipt by customer for defects, stored and installed according to the then most current Ecowarm Installation Manual, and used in conformity with the written specifications in the Manual. Assertions of defect must be presented to Ecowarm in the form of return of goods or other documentation acceptable to Ecowarm. If Ecowarm agrees that the defect is covered by the Ecowarm warranty, then Ecowarm shall, at its expense, ship replacement boards as the sole remedy. Ecowarm specifically disclaims any incidental, consequential or other claims of damage beyond the replacement of defective product. In no event shall damages exceed the cost of the goods provided. Ecowarm is a construction board product, and many aspects of its storage, transport and installation are beyond the control of Ecowarm. Damage from the following are specifically excluded from warranty coverage: improper storage, improper installation, moisture intrusion, improper environmental and system control, abuse, damage from pests, fire, damage from removal of flooring products, and/or reinstallation and acts of God such as earthquakes and floods.



SPECIFICATIONS PART 2 - ORIGINATING MANUFACTURER AND RELATED PRODUCTS

2.01 Approved Board Manufacturer

- A. Ecowarm® RadiantBoard™ shall be manufactured solely by Ecowarm® or by Ecowarms approved manufacturer. No other modular radiant boards may be substituted.

2.02 Tubing

- A. Tubing Installed in Ecowarm® RadiantBoard™ non-structural modular boards shall be third-party certified to and manufactured to ASTM F-876 and F-877.
- B. The PEX tubing shall have PPI issued design and pressure ratings of 200°F @ 80 PSI, 180°F @100 PSI and 73.4°F at 160 PSI.
- C. The PEX tubing shall be nominal 1/2" ID in accordance with ASTM F-876 and F-877, and shall never have loops longer than 350'.

2.03 Glues

See subsequent pages for current recommended products

PART 3 – JOB EXECUTION AND SEQUENCING

3.01 Preparation

- A. Ecowarm® non structural modular board shall be installed according to the contract documents and to the current Ecowarm Installation Manual.

3.02 Modular Board Installation

- A. Using a layout plan, install the Ecowarm boards to the sub-floor as required by the contract documents and the then current Ecowarm Installation Manual. Follow recommended floor assemblies, gluing and attachment tained in Ecowarm Installation Manual.
- B. Reference the planned direction of any wood flooring before installation, and align straight boards at 90° from the direction of the wood flooring. If this is a change from the submitted and approved plan, the plan should be re-done.
- C. Perform any custom routing and drilling before installation of the tubing.

3.03 Tubing Installation

- A. Channels shall be dry, clean and free of any debris before tubing is installed.
- B. The tubing shall be pressed into the channels until it is flush with the top of the board.
- C. Installation shall follow construction documents and an approved plan for tubing layout, manifolds, controls and mechanical room.
- D. Tubing shall be pressurized with air or water, in accordance with codes, or to a minimum of 60 PSI, and maintained through completion of any and all stages of construction that might damage tubing.
- E. Contractor must follow all manufacturer requirements for care and handling of the tubing.

3.04 Subsequent to Tubing Installation

- A. Care shall be taken to protect tubing from damage, debris and prolonged exposure to UV light until covered by flooring goods. Tubing shall be vacuumed before cover.
- B. Flooring goods shall be installed with care to avoid damaging tubing. Particular care must be taken where tubing goes under sills, door jams or radius into walls for manifolds. Inform the other trades of the location of tubing, and protect tubing from damage, with metal plates if necessary.
- C. Pressure test tubing: Check tubing pressure frequently, and keep it under test during any stages of installation and construction that might damage the tubing.
- D. Finish installation and connect to mechanical components as required by construction documents, all codes and good practices.

3.05 Avoid Tubing When Screwing Backboard or Underlayment Plywood to Ecowarm®

- A. Take a photograph as a reference, snap chalklines where the tubing runs are, and avoid screwing to those areas. Remember, tubing runs are 11.75" apart. Take a thick clear sheet of plastic cut it to size, and lay it out over the Ecowarm® once tubing has been installed, then mark with a permanent marking pen the location of the tubing. This may be rolled up and later unrolled and used as a reference to avoid tubing when screwing other products to Ecowarm.

3.06 Recommended Tubing for use with Ecowarm RadiantBoard™

3.6.1 Tubing Installed in Ecowarm® RadiantBoard™ non structural modular boards shall be third party certified to and manufactured to ASTM F-876 and F-877.

3.6.2 The PEX tubing shall have PPI issued design and pressure ratings of 200°F @ 80 PSI, 180°F @ 100 PSI and 73.4°F at 160 PSI

3.6.3 The PEX tubing shall be nominal 1/2" ID in accordance with ASTM F-876 and F-877, and shall never have loops longer than 350' and shorter loops shall be used in circumstances as recommended in this Manual.

3.6.4 DO NOT use PEXALPEX (Pex Aluminum Pex). Ecowarm® RadiantBoard™ has a slightly undercut groove. Regular PEX will oval then rebound into the undercut, and be retained, whereas PEX-AL-PEX will oval and will not expand into the slight undercut. The result is that PEXALPEX will not be as well retained as regular PEX in the groove – it may stand tall of the board.

3.6.5 We recommend these brands of regular 1/2" PEX: Uponor, Zurn, Watts, Mr. PEX, Rehau.

3.6.6 Use of Barrier Pex is recommended in most systems to reduce any potential corrosion of metallic components.



RECOMMENDED ASSOCIATED PRODUCTS

4.0 RECOMMENDED ADHESIVES FOR ECOWARM® AND ECOWARM® EPS PRODUCTS

Ecowarm® has made a major effort to create a green product. We recommend using green, low-VOC adhesives for gluing Ecowarm® to a wood subfloor. Unfortunately, manufacturers use many different methods for stating the amount of VOCs in glue, so it is hard to compare brands. There are two related reasons for using low-VOC adhesives: indoor air quality and the contribution of VOCs to damaging our climate.

There are five major categories of glue compatible with Ecowarm® and Ecowarm EPS™ depending on the adhesives intended type of installation. Before you begin your installation reference the instructions of both the glue manufacturer and any installation drawings elsewhere in this manual.

4.01) Glues for adhering wood flooring, backer board, or underlayment wood material on top of Ecowarm® and Ecowarm® Radiantboard EPS™.

RECOMMENDED ADHESIVES & GLUES FOR ECOWARM®



[SIKABOND T-35](#)



[SIKABOND T-55](#)



[MAPEI ULTRABOND](#)



[BOSTIK GREENFORCE](#)



[BOSTIK GREENGRIP](#)



[BOSTIK BEST](#)



[BOSTIK BST](#)



[BOSTIK EFA+](#)

REGULARLY UPDATED - Check website for most current recommendations. Note: Bostik Green Grip and Bostik WoodGrip Plus are available at Lowes. Bostik Best, Bostik Green Force, and Mapei Eco 980 are available at most lumber liquidators.

4.02) GLUES FOR ADHERING ECOWARM® ONTO A WOOD SUBFLOOR

Most normal construction adhesives will bond Ecowarm to a wood subfloor but low VOC glues contribute less volatile emissions and make for a healthier home. The list below also gives the temperature range at which it may be applied. Coverage Math: Use approximately 25 linear feet of glue per board. Use a minimum 1/8" bead on a very smooth floor and more on an uneven floor. A 28 fluid oz. tube with a 1/8" bead will extrude approx. 340 ft. A 28 fluid oz. tube with a 1/4" bead will extrude approx. 86 ft.

Construction adhesive products marketed as low VOC / their effective temperatures:

OSI SF450 Heavy Duty Construction Adhesive	0°F to 140°F
Bostik Heavy Duty Construction Adhesive	40°F to 100°F
Bostik 975 Construction Adhesive	40°F to 100°F
SikaBond Pro Select Construction Adhesive	40°F to 100°F
Titebond Greenchoice Construction Adhesive	20°F to 120°F
Titebond Provantage Construction Adhesive	0°F to 120°F
Loctite PL 375 Heavy Duty Construction Adhesive	40°F to 100°F

4.03) GLUES FOR ADHERING TO A CONCRETE SUBFLOOR & ADHERING MATERIAL ON TOP OF ECOWARM® RADIANTBOARD™ AND ECOWARM® RADIANTBOARD EPS



[SIKABOND T-35](#)

[SIKABOND T-55](#)

[MAPEI ULTRABOND](#)

[BOSTIK GREENFORCE](#)

[BOSTIK BEST](#)

[BOSTIK BST](#)

4.04) GLUES FOR ADHERING ECOWARM EPS TO CONCRETE SUBFLOOR

Loctite PL300 Foam Adhesive is a latex water-based adhesive formulation for bonding most foam insulation panels to a variety of porous construction materials including but not limited to wood, gypsum board and concrete. It is compatible with all "un-faced" foamboard insulation products and won't burn through foam if used as directed. Low VOC formulation meets stringent State and Federal VOC Regulations.

NOTE: Loctite PL 300 IS NOT COMPATIBLE WITH PEX PIPE.

Bostik Greenforce is available through Lowes as Green Grip.

NOTE: Bostil Greenforce and Green Grip ARE COMPATIBLE WITH PEX



[BOSTIK GREENFORCE*](#)

[LOCTITE PL300](#)



4.05) ROLL ON LIQUID CRACK ISOLATION MEMBRANES FOR USE OVER BACKER BOARD

- USG Durock Liquid Crack Isolation Membrane
- Mapei Mapelastic CI Crack Isolation Membrane
- Redgard from Quikrete
- AquaBlue by Nobel Company
- AquaSeal™ from Nobel Company Water proof crack isolation membrane
- SikaTile-200 Fracture Guard Rapid
- Hydroban XP from Laticrete

4.06) SHEET CRACK ISOLATION MEMBRANES FOR USE OVER BACKER BOARD

- SikaTile®-225 Fracture Guard PNS also some sound deadening up to 3/8"
- NobelSeal TS
- Hydroban from Laticrete Moisture and crack isolation
- Durock Tile Membrane

4.07) PRECAUTIONS TO AVOID PUNCTURING TUBING WHEN INSTALLING BACKER BOARD

- Take a photograph of the Ecowarm™ or Ecowarm EPS™ and tubing before attaching backer board with screws.
- Take a thick piece of clear plastic and make a see-through template of where the tube runs are with a permanent magic marker.
- Use the template to snap chalk lines on the backer board of where to avoid tubing runs when screwing down the backer board.

4.08 ADHERING BACKER BOARD TO ECOWARM® RADIANTBOARD™™ AND ECOWARM® RADIANTBOARD EPS™

- Make sure any adhesive you use is compatible with and will not degrade tubing,
- Most modified Thinsets are compatible with PEX and PERT pipe but call your brand of tubings tech support and get it confirmed. Do this for any adhesive not listed here.
- The following may be used to bond backerboard Ecowarm™ or Ecowarm EPS:
 - Bostik Green Force
 - Bostik Green Grip (Lowes brand of Green Force)
 - Bostik Best
 - Mapei Eco 980
 - Sika T-35
- Also screw the backer board down with screws into the panel every 8" on the edges and every six inches in the field where possible. Make a template of the floor to show where the tubing runs are by using a thick clear plastic and using a marking pen to draw where the tube runs are. Use it to put chalk lines on backer board to avoid screwing into tubing.

4.09 THICKNESS OF BACKER BOARD AND CUTTING BACKER BOARD

- Use a thin dense cementitious backer board such as Hardy 1/4" backer board when possible, because of the low R-value and good heat transfer.
- Wear eye and breathing protection from cement dust when cutting backer board
- Use a product like a Snapper to cut backer board to greatly reduce cement dust. This product may be purchased through home depot and is called a Metal Snapper Shear 6.5 Amp Corded Fiber Cement Backer Board Siding Shear.

CAUTIONS AND LIMITATIONS OF USE

GENERAL CAUTION

As with any radiant heating system do not install Ecowarm® without an accurate room-by-room heat loss analysis for the structure to be heated, as well as a design/layout for Ecowarm™ that takes into account the resistance and heat transfer of the actual floor coverings. If Ecowarm™ cannot provide all the necessary heat, make provisions for additional backup heat.

INSTALLER CAUTION

This manual is deemed to be current at the time of publication. It is the installer's responsibility to install according to the most current Application Guide. This guide does not purport to address all relevant issues; it assumes a knowledge of good practice in both hydronics and construction methods. Installers should always consult all relevant local, regional and national codes, and adhere to good construction practice. Ecowarm™ should only be installed by knowledgeable, qualified installers. Ecowarm™ installations frequently require the coordination of trades. These are, most typically, mechanical and flooring trades. Any issues regarding this coordination should be worked out in advance. Failure to follow the instructions of this guide, failure to adhere to relevant local, regional and national codes, failure to coordinate trades, and failure to follow good construction practice may cause an unsatisfactory result. See also "limitations of use" elsewhere in this publication. The limitations and instructions of use for PEX pipe and all other hydronic components provided by the manufacturers must also be referenced and followed during installation; this manual does not address many aspects of a hydronic installation.

LIMITATIONS OF USE

Ecowarm® is designed for interior use only and is to be installed only on dry substrata once a structure is closed in, protected from the environment, and will remain dry. Ecowarm™ is not intended as, or rated as, a replacement or substitution for a structural sub-floor. The BTU output of Ecowarm® is limited by the R-values of the flooring goods applied over it, and by the recommended and available water temperatures. Ecowarm™ is not intended for use with finish goods incompatible with the temperatures and conditions present in a radiant heating system. Ecowarm™ is not intended as a finish floor, and should be left uncovered and unprotected only during installation.

ECOWARM® IS A PATENTED PRODUCT FROM WARM BROTHERS INC.



WARM BROTHERS INC. – GENERAL TERMS AND CONDITIONS OF SALES AND DELIVERIES

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GENERAL

In these terms and conditions (“Conditions”), “Buyer” means the entity purchasing products, materials, works or services (“Goods”) from Warm Brothers Inc. (“Supplier”), or whose order for such Goods is accepted by the Supplier.

SALES

The Supplier shall sell and supply the Goods to the Buyer subject to these Conditions, which shall exclusively govern the contract (“Contract”) for the sale of the Goods provided by the Supplier hereunder, to the exclusion of any other terms and conditions of the Buyer.

ORDERS AND SPECIFICATIONS

No order submitted by the Buyer is accepted by the Supplier unless confirmed in writing by the Supplier, or upon delivery of the Goods by the Supplier. Supplier shall be entitled to accept or reject orders and customers at its sole discretion.

PANEL LAYOUT

Buyer acknowledges that Supplier recommends using Supplier’s panel layout service which provides a detailed layout of the radiant panel shapes, loop lengths, zoning and manifold locations specific to the Buyer’s project needs. With a panel layout plan, due diligence, and adherence to the Supplier’s current Installation Manual for the product, many individuals and contractors may successfully install the radiant panels. However, the integration of overall heating requirements, design, and components of a hydronic radiant heating system requires specialized knowledge. Therefore, as a condition of sale, the Buyer acknowledges being either a knowledgeable, qualified installer trained in the installation, codes, permitting, safety, heat transfer, piping and other relevant issues relating to installing hydronic systems, or, if not, Buyer will use a qualified installer for integrating, testing and starting up the system. The Buyer further acknowledges that if they want to buy Warm Brothers Inc.’s radiant panel products without a layout design, they must sign a form saying they have read the Installation Manual and are qualified to install the goods purchased from the Supplier. At a higher cost, Buyers of Ecowarm Radiant Board can, in some regions, be provided a full mechanical design.

PAYMENT TERMS FOR INVOICES

The Buyer shall pay the invoice (in full without any offset, deduction or counterclaim) in U.S. Dollars, unless the Supplier specifies otherwise. Due to the volatility of freight and material prices, the validity of estimates and invoices will be for the time limit stated on the invoice or estimate. After the expiration of any estimate or invoice, at Supplier’s sole discretion, the estimate or invoice will either be extended, or redone at the then prevailing price of freight and goods. Invoices will contain a link to pay electronically. Supplier accepts Visa, Mastercard, Discover, American Express, and

eCheck (electronic check) transfers. Supplier requires prepayment before shipment of our radiant panel products.

ESTIMATE PROCESS, INVOICES AND PAYMENT

Budgetary estimates are provided by Supplier to Buyer free of cost. Supplier invoices Buyer a cost for layout design services, as agreed in advance by the Buyer. A portion of this design fee may be credited back to the Buyer when the radiant panel product is purchased. Once a Buyer has accepted the final design, Supplier will send Buyer an Invoice for Goods based on the layout design, which normally requires prepayment prior to Supplier shipping product.

SHIPPING AND FREIGHT

Supplier’s quotation or estimate to Buyer includes a freight quote that can be affected by issues such as those enumerated below. A Buyer’s shipping requirements may change, as well as the freight estimate, prior to delivery. Since freight costs vary with each order, Supplier generates and includes a custom freight quote for each Buyer.

Supplier’s board shipments are usually sent out by an LTL trucking company. The least expensive way to ship these boards is to ship to a commercial location that operates during regular business hours, has a forklift, and has personnel available to unload the boards. If this option is not available, the freight company will charge extra delivery fees. Below is a list of special services that affect freight charges. These delivery conditions should be discussed by Supplier and Buyer prior to purchase. If delivery conditions change, Buyer should notify Supplier of such changes prior to delivery; this may result in additional cost.

Delivery options that may affect shipping and freight cost:

- Inside property drop-off (long driveways, specific drop spot)
- Liftgate drop-off (if Buyer or site does not have a forklift to unload boards from the truck)
- Limited Access Delivery (i.e. construction sites, utilities, churches, schools, etc.; a steep long driveway; no turn around space; gated community)
- Phone notification required prior to delivery
- Appointment delivery (within a set time window); redelivery if Buyer misses appointment
- Residential Delivery
- Redelivery (second attempt if no one was at original delivery)

INSPECTION OF GOODS UPON DELIVERY

The Buyer shall inspect the Goods upon delivery. Heavily damaged shipments should be rejected at the time of delivery. Any claim for any defect in the quality or condition of the Goods shall be presented in writing to the Supplier



WARM BROTHERS INC. – GENERAL TERMS AND CONDITIONS OF SALES AND DELIVERIES

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within five (5) working days of delivery or, where the defect was not immediately apparent, within five (5) working days of discovery.

DELIVERY AND PERFORMANCE

Terms of delivery shall be by freight prepaid by the Buyer, unless otherwise agreed. Any dates quoted for delivery of Goods are estimates only, and the Supplier shall not be liable for any transit delay in the delivery of Goods. If Supplier cannot ship purchased Goods within three weeks of a pre-agreed date with the Buyer, then the Buyer may cancel the order for Goods not yet shipped, including freight, and will receive a full refund, with the exception that design layout costs are not refundable.

DEFECTIVE GOODS

In case of defective Goods, the Supplier may, at its sole option, replace or repair the Goods free of charge, or refund the price of the Goods. The foregoing shall be the Buyer's only and exclusive remedy. Under no circumstances shall the Supplier be liable to the Buyer for loss of contracts, profits, revenue, business, goodwill or other indirect or consequential loss, regardless of the ground of the claim. Notwithstanding anything to the contrary in the Contract or these Conditions, the Supplier's entire liability shall never exceed the price of the Goods provided.

TRANSFER OF OWNERSHIP

Risk of Loss transfers to the Buyer upon delivery. Transfer of Ownership normally transfers to the Buyer at time of delivery, provided Supplier has received clearance of all funds due for Goods being supplied.

TAX

Supplier's Goods are sold electronically on the internet, and under some conditions no tax is charged. However, ongoing U.S. Supreme Court decisions on internet taxation, as well as evolving state-by-state internet sales tax requirements, means that all U.S. suppliers are presented with a complex and fluctuating array of laws regarding internet sales and use taxes. We comply with these as we become aware of the specific tax obligation in any state. Therefore, we reserve the right to charge tax at the time of sale. You, the Buyer, acknowledge that you are responsible for paying any sales tax, use tax or fees that may be due in your locality, state or other legal jurisdiction. If a Buyer has a valid resale certificate in a state where we are charging tax, the Buyer may provide Supplier a valid copy of this resale certificate and the Supplier will not charge the tax.

RETURNS AND CANCELLATIONS

Supplier's products are assembled and packaged for each Buyer's order, with the component configuration of the Buyer's requested order and Supplier's Invoice. Payment in

full is required prior to preparing an order. A Buyer's order may be cancelled with a 95% refund if the cancellation is requested before our factory has begun assembling the order. If a Buyer's order is cancelled after packaging has started, but prior to shipment, the order may be cancelled subject to a 35% cancellation fee.

Any Buyer's order that is to be returned to the factory requires factory approval and an RGA, (Return Goods Authorization), and must be returned within 10 working days of receipt of Goods by the Buyer, provided that it: 1) has not been installed, 2) is in original condition, and 3) is returned in the original packaging. An RGA# (Return Goods Authorization) from Supplier is required for any such return.

Return instructions will specify where and how to ship the product, and the RGA# and documentation must accompany each box or pallet of any such shipment. Buyer is required to pay shipping/freight charges on all returned Goods. Returned Goods are subject to Supplier's 35% restocking fee.

The balance of Buyer's purchase price, less any additional shipping charges or restocking fee, will be refunded within 10 working days of the factory receiving the Goods, if the Goods are in resalable condition, meaning they have not been installed, abused, altered or damaged. If the factory rejects the returned Goods for the above reasons, no refund to the Buyer will be issued. Warranty returns must also be agreed to in advance by the factory, and must have an RGA#.

BUYER INTENDED USE

Buyer acknowledges that the Supplier's radiant panel products are intended for indoor use as a non-structural modular radiant panel system, are intended to be stored, installed and used according to the most current Warm Brothers Inc. radiant panel Installation Manual for the product, and have been integrated into the Buyer's overall mechanical system by qualified installers familiar with hydronic good practices, and installed in compliance with all relevant codes.

PRIVACY AND SECURITY

Warm Brothers Inc. values your privacy. We do not share a Buyer's confidential information with anyone other than as required by credit processors to complete a transaction, or if compelled by law. We do, however, provide our factory with each Buyer's name, company, address, phone, fax and e-mail for shipping purposes. We keep information regarding transactions as long as required by law.



WARM BROTHERS INC. – GENERAL TERMS AND CONDITIONS OF SALES AND DELIVERIES

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INTELLECTUAL PROPERTY

Supplier retains all right, title and interest in and to all intellectual property rights ("IPR") regarding the Goods, and to all confidential information (including, but not limited to, drawings, designs, specifications), as well as the results of any joint development, and any IPR of whatever nature contained therein. The Buyer shall not receive any right to Supplier's IPR or confidential information.

EFFECT OF WAIVER

No waiver by the Supplier of any breach of the Contract by the Buyer shall be considered a waiver of any subsequent breach of the same or any other provision. If any provision of the Contract is held to be invalid or unenforceable, the validity of the other provisions of the Contract shall not be affected. Buyer shall not assign or transfer this contract without prior written consent of Supplier.

FORCE MAJEURE

Supplier's performance shall be excused, and Supplier shall not be liable or responsible to Buyer, nor be deemed to have breached any obligation to Buyer, in the event of any acts of God; flood, fire, earthquake, or other natural disaster; disease; explosion, war, invasion, hostilities, terrorism, riot, or other civil unrest; government action, order or law, embargoes, or blockades; national or regional emergency; strikes, labor stoppages or slowdowns, or other industrial disturbances; shortage of adequate power or transportation facilities; or other events beyond the control of Supplier.

WARRANTY

Warm Brothers Inc. warrants that its non-structural modular board products are free from defects in material and workmanship in the manufacturing process when shipped from the factory. For a period of one (1) year after shipment from the factory, any boards that are determined to have been defective when they left the factory will be replaced by a like number of boards as the exclusive remedy. To qualify for warranty, Goods must be inspected upon receipt by Buyer for defects, stored and installed according to the most current Warm Brothers Inc. Installation Manual for the product involved, and used in conformity with the written specifications in the manual. Assertions of defect must be presented by Buyer to Warm Brothers Inc. in the form of a request for return of goods within 7 days of receipt, or by other documentation acceptable to Warm Brothers Inc. If Warm Brothers Inc. agrees that the defect is covered by the Warm Brothers Inc. warranty, then Warm Brothers Inc. shall, at its expense, ship the Buyer replacement boards as the sole remedy. Warm Brothers Inc. specifically disclaims any incidental, consequential, or other claims of damage beyond the replacement of defective Goods. In no event shall damages exceed the cost of the goods provided.

LIMITATIONS TO LIABILITY

Supplier specifically disclaims any liability for property or personal injury damages, special or punitive damages, consequential, incidental, or contingent damage for lost profits, revenues, down time, shutdown or slow-down costs, or for any other types of economic loss; or for claims of Buyer's customers or any third party for any such damages. Warm Brothers Inc.'s total liability arising in connection with the Goods shall be limited to the value of the product provided to the Buyer.

EXCLUSIONS TO WARRANTY

Any product that has been removed and reinstalled is excluded from warranty coverage. Radiant Panels provided by Warm Brothers Inc. are construction board products, and many aspects of their storage, transport and installation are beyond the control of Warm Brothers Inc. Lack of Buyer's inspection of product at time of delivery, or lack of notification within 7 days to Warm Brothers Inc. of any defect or damage, excludes Goods from warranty coverage.

- Improper storage
- Jobsite damage caused by others
- Installation for any use other than the Goods' intended use
- Installation in violation of guidelines in the Installation Manual

JURISDICTION, FORUM AND DISPUTES

Buyer acknowledges that any claims brought against Supplier for breach of warranty, or for any other reason, shall be governed and construed by the laws of the State of Washington without resort to any conflict of laws principles. For any disputes arising from Warm Brothers Inc.'s Limited Warranty, or any other dispute, the parties agree to the exclusive jurisdiction of federal and state courts located in King County, Washington. Each party hereby waives any right it might otherwise have, but for this provision, to file a motion to dismiss or transfer jurisdiction from such courts based on lack of personal convenience or forum non conveniens. Any dispute, controversy, or validity thereof, shall be finally settled by arbitration in accordance with the Arbitration Rules of the American Arbitration Association. The number of arbitrators shall be one (1). The seat of arbitration shall be Seattle, Washington, USA. The language of the arbitration shall be English. Without prejudice to the clause above, the Supplier, at its sole discretion, reserves the right to sue the Buyer at the general place of jurisdiction for the Buyer.

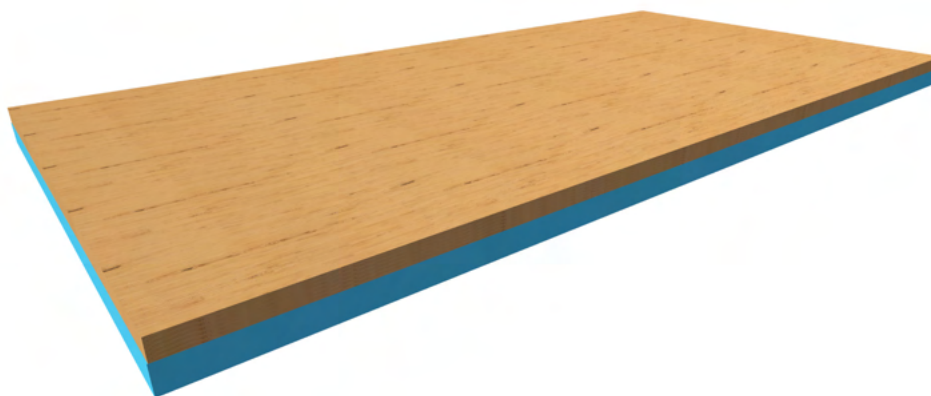
COMPLETE AGREEMENT

All of the above policies and practices are specifically incorporated as conditions of sale from Supplier to Buyer. By purchasing on this website, the Buyer specifically acknowledges and accepts these conditions of sale.

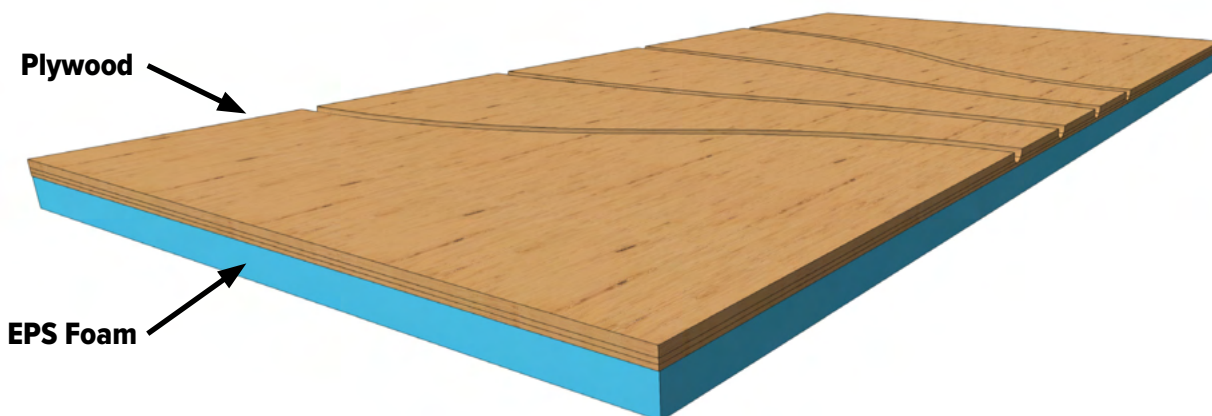
APPENDIX 1: SPECIAL ORDER UNFOILED ECOWARM® RADIANTBOARD EPS™ BLANK FILLER BOARDS

Warm Brothers Inc. will be offering special order unfoiled blank filler boards in some markets as an alternative to using our regular EPS boards or layers of sheet goods as fillers or for boards to custom route tubing to manifolds in closets or other locations. Where available the part numbers will be as follows:

PART NUMBER	DESCRIPTION	DIMENSIONS
ECO-EPS-BLNK-0.375	NON-FOILED BLANK	23.5" X 47"
ECO-EPS-BLNK-0.50	NON-FOILED BLANK	23.5" X 47"
ECO-EPS-BLNK-0.75	NON-FOILED BLANK	23.5" X 47"
ECO-EPS-BLNK-1.0	NON-FOILED BLANK	23.5" X 47"
ECO-EPS-BLNK-1.50	NON-FOILED BLANK	23.5" X 47"
ECO-EPS-BLNK-2.0	NON-FOILED BLANK	23.5" X 47"



Blank Ecowarm® Radiantboard EPS™ boards may be used as fillers or custom routed to run tubing to manifolds or run many loops down a hallway.



ECOWARM® RADIANTBOARD™ APPLICATION AND INSTALLATION MANUAL

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U.S. PATENT #6,533,185

Ecowarm® Radiantboard™ is sold under a license from

WARM BROTHERS INC.

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